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**F-35 PROGRAM UPDATE:
SUSTAINMENT, PRODUCTION, AND
AFFORDABILITY CHALLENGES**

JOINT HEARING
BEFORE THE
SUBCOMMITTEE ON READINESS
MEETING JOINTLY WITH
SUBCOMMITTEE ON TACTICAL AIR AND
LAND FORCES
OF THE
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F-35 PROGRAM UPDATE: SUSTAINMENT, PRODUCTION, AND AFFORDABILITY CHALLENGES

HOUSE OF REPRESENTATIVES,
COMMITTEE ON ARMED SERVICES,
SUBCOMMITTEE ON READINESS, MEETING JOINTLY WITH THE
SUBCOMMITTEE ON TACTICAL AIR AND LAND FORCES,
Washington, DC, Wednesday, November 13, 2019.

The subcommittee met, pursuant to call, at 10:00 a.m., in room 2118, Rayburn House Office Building, Hon. John Garamendi (chairman of the Subcommittee on Readiness) presiding.

Mr. GARAMENDI. The hearing will come to order, and we will begin with opening statements. The normal process here is for—I will open and then I am going to turn to Mr. Lamborn, and then Mr. Norcross, and then Mrs. Hartzler.

OPENING STATEMENT OF HON. JOHN GARAMENDI, A REPRESENTATIVE FROM CALIFORNIA, CHAIRMAN, SUBCOMMITTEE ON READINESS

Mr. GARAMENDI. Good morning. I want to welcome everyone to this hearing, especially to my colleagues, who are Ron and Vicky and Doug, when he shows up—

[Laughter.]

Mr. GARAMENDI [continuing]. To this hearing—joint hearing of the Readiness Subcommittee and Tactical Air and Land Forces Subcommittee concerning the F-35 program.

The hearing comes at a very critical time for the F-35 program. After nearly two decades of development, the aircraft has entered into its operational testing period and is actively deployed around the globe, and has seen its first combat missions.

Acquisition continues apace. We have delivered over 450 F-35s to the Air Force, Navy, Marines, and key international partners. By 2023, the fleet is expected to include more than 1,100 aircraft stationed at 43 operational sites.

As the Department of Defense's costliest weapon system, it goes without saying that the F-35 has been the subject of much concern, criticism, and occasional optimism.

With acquisition costs expected to exceed \$406 billion and sustainment costs estimated at more than a trillion over its 60-year life cycle, this scrutiny is warranted.

In fact, sustainment activities will ultimately contribute to 70 percent of the program's total costs.

So, today's discussion, the first F-35 hearing led by the Readiness Subcommittee, will rightfully focus on sustainment issues.

The F-35 sustainment enterprise faces formidable challenges. These include unacceptable high operating and support costs; inad-

equate repair capacity at depots; spare parts shortages compounded by insufficient reliability of parts, components; and deficiencies in the platform's ALIS [Autonomic Logistics Information System] system.

As a result of these problems, only about half of the F-35 fleet was available to fly at any given time in 2017 and 2018.

The program has had a complex relationship with its prime contractors, Lockheed Martin and Pratt & Whitney, who bear the responsibility for some of the program's sustainment challenges and problems, and from whom we will hear in the second panel.

While the Department paid insufficient attention to sustainment in the program's early years—that bears repeating but I won't at the moment—we have seen an increased focus on the problems of sustainments resulting in measurable progress, and we acknowledge that progress.

Costs per flying hour are decreasing and the aircraft's mission capability rates, while still too low, did increase this year, partially as a result of the spotlight placed on improving mission capability by former Secretary of Defense Mattis.

Yet, attention to these problems must outlast any particular leader or directive. As we look ahead to the next few decades of the F-35 service, failing to create an effective cost-efficient sustainment system will diminish readiness, squander taxpayer resources, and discourage the services and our partners from continuing to purchase the F-35.

This would create unacceptable risks for the program and would be an abdication of the trust and investment of the public and our allies.

The capabilities the F-35 brings to the battlefield are essential to the objectives of our new National Defense Strategy and to those of our international partners.

I am not interested in dwelling on the mistakes of the past, but I do think we all agree that the stakes are too high for us to allow this program to fail and we all—the Congress, the Senate, the Department of Defense, and the contractors—we all must take a constructive and collaborative approach toward solving the F-35 sustainment challenges, and I look forward to discussing how we can do that in today's hearing.

Now, with the arrival of my colleague and ranking member of the subcommittee, and by the rules of this committee, I turn to Mr. Lamborn.

[The prepared statement of Mr. Garamendi can be found in the Appendix on page 57.]

STATEMENT OF HON. DOUG LAMBORN, A REPRESENTATIVE FROM COLORADO, RANKING MEMBER, SUBCOMMITTEE ON READINESS

Mr. LAMBORN. Well, thank you, Chair—Chairman Garamendi. I truly appreciate the opportunity to conduct this joint hearing with our colleagues on the Tactical Air and Land Forces Subcommittee, which I am also on. So, I guess I will wear two hats, along with Vicky Hartzler and others.

The F-35 program is an example of a program that seems to be like it was designed so that it is too big to fail. From the program's

inception, the Pentagon has struggled to resolve conflicts between the services regarding the Joint Strike Fighter's requirements, failed to protect the government's ownership of an intellectual property that was funded by taxpayer dollars, and failed to manage cost growth.

Lockheed Martin has delivered over 458 aircraft to our military and to international partners participating in the program. We now enter the period where sustainment and readiness of the F-35 fleet are critical to our national security.

One of the biggest concerns I have is whether the government has full access to the intellectual property required to sustain the F-35.

I look forward to hearing from our witnesses in both panels about how we are addressing that issue. We are at risk of allowing one company to be in a monopolistic position to the government, which would enable it to charge a premium for sustainment contracts.

My next concern is that we must build capacity within the depots and maintenance systems of our Armed Forces. Failing to do so will guarantee future sustainment challenges.

When you talk to the pilots and maintainers in the field, they have serious questions about the Autonomous Logistics Information System, known as ALIS, that supports mission planning, supply chain management, and maintenance.

Operators are spending countless hours inputting data that is supposed to be automated. From my perspective, it appears that the software architecture is outdated, and I look forward to discussing the way ahead.

Within the data management part of the program, I am also deeply concerned about simulator support for the force. My understanding is that there are significant issues in replacing the servers that support these systems, which significantly reduces the ability of our pilots to train.

Finally, supply chain management for F-35 is still a work in progress and has a long way to go. The prime contractor is responsible for maintaining—excuse me, managing replacement parts packages and government personnel onsite have limited to no visibility into the actual parts on hand.

We are receiving consistent feedback from the field that these packages are not configured for the correct version of the aircraft that they were supposed to be supporting.

Because the contractor is managing the supply chain instead of the military managing the supply chain, the program is incurring unnecessary costs to move parts between countries and to support our partner nations.

So, I want to thank our witnesses for being here today and for their testimony, and I know you are working hard to address these shortcomings. The foundation of these problems were laid decades ago, in some cases.

But we have to pick up the pace on sustainment as we get closer to full-rate production. At \$406 billion for acquisition and more than \$1 trillion estimated for sustainment, we cannot afford any further mismanagement of this program.

Mr. Chairman, I yield back.

[The prepared statement of Mr. Lamborn can be found in the Appendix on page 59.]

Mr. GARAMENDI. Thank you, Mr. Lamborn.

I now turn to my colleague, chairman of the Tactical Air and Land Forces Subcommittee, Don Norcross.

Your opening remarks, sir.

STATEMENT OF HON. DONALD NORCROSS, A REPRESENTATIVE FROM NEW JERSEY, CHAIRMAN, SUBCOMMITTEE ON TACTICAL AIR AND LAND FORCES

Mr. NORCROSS. Thank you, Chairman.

I want to thank my good friends from California, Colorado, and Missouri for agreeing to this joint hearing with the Readiness and Tactical Air and Land Forces.

I welcome, too, the distinguished panels of witnesses for taking the time to come before us. To meet our constitutional oversight responsibilities, we must hear from the Department program leaders as well as those independent agencies that help us evaluate program progress or shortfalls.

We should also take the opportunity to get on the record the testimony from our two prime contractors responsible for production and sustainment of this critical capability for the warfighter and for the American taxpayer, who is funding the program.

I agree with everything that has been said so far and note that the F-35 program is trying to recover from risky acquisition decisions made by past program leaders—previous decisions that resulted in unforeseen increases in funding for development [and] production to address the failing assumptions made for the high concurrency designed into this program.

That bill for the past “acceptable” concurrency risk is now due and has resulted in the significant fiscal challenges facing us today. Block 3F configured aircraft delivered today are only somewhat combat mission capable.

There are still material deficiencies that negatively impact the low-observability characteristics of this aircraft, and that is only a fifth-generation aircraft that can provide.

And yet, as the system development and design phase of the program has officially ended, we now embark on the next upgrade known as Block 4, which is estimated to cost an additional \$20 billion in development and retrofit costs for both today’s fielded aircraft and future production aircraft to achieve full combat capability.

Today, we want to understand what fixes you are making to the struggling ALIS system, which we have heard from two of our colleagues so far.

Where are we finding the qualifying alternate sources of supply resulting from Turkey’s suspension from the program? And what strategy and execution plan to establish greater capacity, effectiveness, and insight with the prime contractor deficiencies with supply chain parts management and the concurring—that are currently plaguing the efficiency of the production line?

Finally, I would like to learn from the Department what they are doing to establish common cost categories and metrics, and evalu-

ating the true ownership cost of the aircraft, whether defined in terms of cost per flight hour or cost per tail year.

I believe it is imperative for leaders to establish a Department-wide policy for guidance when we are comparing costs—apples-to-apples input between some of the legacy programs and the future generation aircraft.

The Tactical Air and Land Subcommittee will continue to support the program, but we don't have unlimited resources, which seem to continually need this elusive term "affordability."

With that, I again look forward to the hearing and yield back to my chairman.

[The prepared statement of Mr. Norcross can be found in the Appendix on page 61.]

Mr. GARAMENDI. I thank you, Mr. Norcross.

Mrs. Hartzler.

STATEMENT OF HON. VICKY HARTZLER, A REPRESENTATIVE FROM MISSOURI, RANKING MEMBER, SUBCOMMITTEE ON TACTICAL AIR AND LAND FORCES

Mrs. HARTZLER. Thank you.

As the chairman mentioned, this hearing continues the committee's ongoing oversight and continuing review of the F-35 program.

As members of this committee, we understand and recognize the importance of fifth-generation capability as well as the need to grow additional fifth-generation capacity in order to meet the objectives of the National Defense Strategy and maintain a credible deterrence posture.

I was pleased to see the latest F-35 production contract award, the largest in the history of the Department of Defense, has resulted in significant lower unit recurring flyaway costs for the F-35 from \$89.3 million per F-35A aircraft of the previous contract to \$77.9 million for this contract award, representing a 12.8 percent decrease.

According to the Joint Program Office, this \$34 billion agreement will see the delivery of 478 F-35 aircraft, which will almost double the size of the current F-35 fleet by 2022.

However, given the size, the scope, and complexity of the program [and] that the fleet size will nearly double over the next 2 years, this hearing provides a timely opportunity to update our members on the challenges currently facing the program going forward, to include what actions are being taken now to ensure long-term affordability and drive down sustainment costs.

I want to briefly run through a few issues that I expect the witnesses to cover today. Regarding Turkey's recent suspension and ultimate removal from the program, I join Chairman Norcross in an interest in receiving an update on the current posture of the F-35 industrial base to include qualifying and ramping up alternative sources for the parts that were being produced in Turkey.

I also expect the witnesses to update us on the acquisition plan, cost estimates, and a test strategy for the Block 4 modernization program.

I understand next year's budget request will be the first production year for Block 4 aircraft and I would like to know whether you are experiencing any challenges with the overall Block 4 develop-

ment schedule and will these new aircraft result in higher unit costs.

We were recently notified that the full-rate production decision has been delayed by over a year and I am interested in hearing what programmatic impacts this delay would have, if any, on the program's current acquisition strategy.

Today's hearing is also a good time to update us on some of the outcomes from the initial operational testing [and] evaluation that is ongoing, specifically the challenges associated with developing the joint simulated environment capability which is needed to realistically test fifth-generation capability.

And, finally, I would appreciate the witnesses to the degree they can in an open hearing address how they are approaching cybersecurity concerns and testing, specifically as it relates to ALIS, which has been mentioned—the [Autonomic] Logistics Information System—and the overall integrity of the supply chain.

So, I want to thank our witnesses for being with us today. I look forward to an open and candid discussion and, with that, thank you, Mr. Chairman.

I yield back.

[The prepared statement of Mrs. Hartzler can be found in the Appendix on page 63.]

Mr. GARAMENDI. Thank you, Mrs. Hartzler.

I would now like to welcome to the hearing our witnesses on the first panel: Honorable Ellen Lord, Under Secretary of Defense for Acquisition and Sustainment; Lieutenant General Eric Fick, Program Executive Officer for the F-35 Joint Program Office; Robert Behler, Director of Operational Testing and Evaluation at the Office of the Secretary of Defense; and Ms. Diana Maurer, Director of Defense Capabilities and Management at the Government Accountability Office [GAO].

I am going to start with the Government Accountability and let us get an outline of what has happened. I know that the GAO has been on this issue for a long, long time—multiple reports over the last several years.

So, Ms. Maurer, if you would care to start us off. All that is good and not so good.

STATEMENT OF DIANA MAURER, DIRECTOR, DEFENSE CAPABILITIES AND MANAGEMENT, U.S. GOVERNMENT ACCOUNTABILITY OFFICE

Ms. MAURER. We will give you the full picture.

Thank you very much, Mr. Chairman.

Mr. GARAMENDI. Thank you. Pull that microphone up close and be personal with it.

Ms. MAURER. All right. Sure.

Mr. GARAMENDI. Thank you.

[Laughter.]

Ms. MAURER. I am pleased to be here today to discuss GAO's findings and recommendations on F-35 sustainment.

U.S. air power depends on the F-35, and when we talk to pilots and mechanics in the field, we hear good things that they have to say about the amazing capabilities of the aircraft.

But the success of the F-35 ultimately depends on sustainment and for too many years sustainment has taken a back seat. While in recent years this has changed for the better, DOD [Department of Defense] has increased its attention and commitment to sustainment challenges.

Let there be no doubt, the program is trying to dig itself out of a big hole. Many important plans, agreements, and details on how to supply and maintain the F-35 were not worked out before the Marines, Air Force, Navy, and international partners began using the aircraft.

As a result, we have a very capable, very expensive system that is not flying nearly as often as planned. During the last fiscal year, F-35s were on average able to perform one of their many potential missions less than two-thirds of the time and all missions only about one-third of the time.

These figures are far from the goals set by the Secretary of Defense and the services. Our work has identified several reasons for these outcomes.

First, there are not enough spare parts to go around. As we reported earlier this year, F-35s cannot fly about 30 percent of the time due to supply issues.

In addition, parts are breaking more often than expected, it is taking twice as long as planned to fix them, and the necessary depot repair capabilities won't be completed until 2024.

And then there is ALIS, the information system vital to the F-35's maintenance, logistics, and mission execution. If ALIS doesn't work, the F-35 doesn't work, and ALIS has been struggling for years.

In addition, DOD's options for improving sustainment are constrained by the overall structure of the program. For example, contractors largely own the technical data, provide the spare parts, and manage the global logistics system.

Now, to help with these challenges, my statement today discusses 21 recommendations we have made over the past few years and DOD by and large agrees and has started taking action to address most of them, and that is very encouraging.

However, improving sustainment will not be quick and it will not be easy. It will require action by DOD, action by the contractors, continued robust congressional oversight, and full implementation of GAO's recommendations.

Continued focus and action on sustainment is necessary to ensure the F-35 is able to meet our national security goals for many decades to come.

Mr. Chairman, thank you for the opportunity to testify this morning and I look forward to your questions.

[The prepared statement of Ms. Maurer can be found in the Appendix on page 65.]

Mr. GARAMENDI. I want to thank you and your colleagues at the GAO for its work—your work—over almost two decades now on this program. We would do very well in our role of oversight to pay attention to the 21 recommendations that you have made.

And I will now ask Ms. Lord for her review of those 21 recommendations.

Ms. Lord.

**STATEMENT OF HON. ELLEN M. LORD, UNDER SECRETARY OF
DEFENSE FOR ACQUISITION AND SUSTAINMENT, OFFICE OF
THE SECRETARY OF DEFENSE**

Secretary LORD. Good morning.

Mr. GARAMENDI. Thank you.

[Laughter.]

Secretary LORD. Chairman Garamendi, Ranking Member Lamborn, and distinguished members of the Readiness Subcommittee, Chairman Norcross, Ranking Member Hartzler, and distinguished members of the Tactical Air and Land Forces Subcommittee, thank you for the opportunity to testify.

I am pleased to join Robert Behler, Lieutenant General Eric Fick, Diana Maurer to discuss our continued efforts to develop, build, and sustain an affordable and ready F-35 air system.

With more than 458 fielded aircraft operating from within the U.S. and abroad, our warfighters are beginning to experience the true game-changing capabilities the F-35 brings to bear as well as identifying challenges that need to be addressed.

As Under Secretary, I have maintained a laser focus on driving down costs, improving quality, and increasing fleet readiness. The Department is actively transforming the F-35 program to deliver the efficiencies, agility, and readiness outcomes we need in a time of strategic competition.

I would like to briefly walk through how the F-35 enterprise is working to dramatically improve F-35 sustainment outcomes by focusing on a subset of our actions to achieve the Department's goals of improving aircraft availability and reducing sustainment costs.

I have submitted a more in-depth statement for the record.

As the F-35 fleet continues to grow and the air system's capabilities are enhanced, it is crucial that we stay focused on improving fleet readiness to ensure the F-35's critical capabilities are available to the warfighter.

I would like to thank Congress for their support in helping us maintain a balanced investment approach. With your help, the program continues to make steady progress in enhancing fleet readiness, but much work remains.

My team has identified several success elements that we have documented in a comprehensive life cycle sustainment plan—we call it LCSP—that are required to drive fleet readiness improvements.

For example, we are focussed on a number of efforts to accelerate supply chain improvements, to increase supplier capacity, decrease lead times for spares, and optimize spares available on the shelf.

The Department is also accelerating depot component repair activations by 6 years to meet fleet component repair demands. Additionally, we are working to improve ALIS field-level functionality and responsiveness.

ALIS is a key enabler to the platform's operational availability and, sadly, as presently constituted, ALIS is not delivering the capabilities the warfighter needs.

The Department is progressing towards a future ALIS developed and sustained utilizing agile software development techniques designed to rapidly deliver flexible applications on a modern, secure architecture.

I see a number of our industry partners demonstrating a high degree of confidence in developing the kinds of open architectures needed to support the warfighter.

The problems with ALIS are ones we can and must solve. The F-35 enterprise recognizes that the U.S. services, the F-35 JPO [Joint Program Office], and industry must collaborate to reduce sustainment costs.

I am personally overseeing an effort to understand the barriers preventing more rapid improvement to both readiness and affordability.

The intent is for the F-35 program to uncover performance drivers and apply commercial best practices where appropriate to targeted interventions.

The Department is using these insights to support accelerated implementation of key success elements in our LCSP. Specifically, we have identified that driving down support costs, both in terms of labor cost and labor demand, is the key lever in reducing overall F-35 sustainment costs because sustainment support accounts for over a third of all sustainment costs.

Additionally, as we learn more about the readiness barriers and the cost drivers, we are using this knowledge to help inform our analysis of Lockheed's 5-year fixed-price performance-based logistics, or PBL, proposal.

We are in the early stages of working in conjunction with our industry partners to analytically understand if, when, and to what scope an F-35 PBL contract could be awarded.

Our goal is to ensure that any such contract meets the readiness and affordability goals important to the F-35 warfighter and in the best interest of the American taxpayer.

In conclusion, the Department continues to demonstrate our commitment to provide an affordable, lethal, supportable, and survivable F-35 air system.

While the Department is grateful to Congress for passing a 2-year budget agreement that provides budgetary certainty the Department needs to implement the National Defense Strategy, I want to reiterate how regrettable it is that we are, again, under a continuing resolution. CRs cause great damage to military readiness and disrupt our ability to modernize our forces.

I strongly urge Congress to pass a defense appropriation and authorization bill now so what we can move forward with the many important programs needed to ensure our readiness and deter our adversaries.

I want to thank both subcommittees for your longstanding bipartisan support and I look forward to your questions.

[The prepared statement of Secretary Lord can be found in the Appendix on page 88.]

Mr. GARAMENDI. Thank you very much, Ms. Lord.

Yes, we are going to go at those issues that you raised. That is the subject of the hearing. We will get at it.

Lieutenant General Fick.

STATEMENT OF LT GEN ERIC T. FICK, USAF, PROGRAM EXECUTIVE OFFICER, F-35 LIGHTNING II JOINT PROGRAM OFFICE

General FICK. Chairman Garamendi, Chairman Norcross, Ranking Members Lamborn and Hartzler, and distinguished members of the Readiness and Tactical Air and Land Forces Subcommittees, thank you for the opportunity to be here today.

I am pleased to have this opportunity to join Under Secretary Lord, Director Behler, and Director Maurer to discuss our continued and collective efforts to develop, deliver, and sustain the F-35 air system with the capabilities our warfighters demand at a price our taxpayers can afford.

Since becoming the F-35 PEO [Program Executive Officer] this past summer, I have been both impressed by and proud of the progress that my joint and international team has made, together with our industry partners, in modernizing and sustaining the air system now deployed in combat operations around the world.

Ranking Member Hartzler noted our recent production contract award, but production success, of course, is nothing if not followed by progress in the area of sustainment.

As our operational fleet continues to grow, we are committed to maturing our global sustainment solution to increase aircraft availability while simultaneously driving down operations and support costs.

As you well know, if we are missing parts and we can't get our jets airborne, the ability to deliver combat effects on this aircraft are significantly diminished.

Getting parts to the field when they are needed, expeditiously repairing broken parts, and improving the reliability and the maintainability of the aircraft are all critical items we need to achieve to get to consistently higher mission capability rates while simultaneously driving down sustainment costs.

While I am both personally and professionally unsatisfied with where we are today, I will offer that we are seeing measured progress on both fronts. Actions undertaken by the F-35 enterprise and by our warfighting maintainers in 2019 increased the mission capability [MC] rates of our U.S. operational fleet from 55 percent in October of 2018 to 73 percent in September of 2019, even as our fleet grew by an additional 91 aircraft. That is the MC rate of a single deployed unit.

In this past summer, our four deployed Air Force units from the 388th Fighter Wing at Hill led the first F-35A combat employment, encompassing 1,319 sorties for 7,248 flight hours.

I am pleased to share that the 388th saw their mission capability rates increase from 72 percent in April to 92 percent by the time they returned in October. We know what success looks like and we must make that the norm for the program, not the exception.

Just as in aircraft availability, we are also making steady measured progress in bringing down our sustainment and operating costs for the F-35.

While much work remains ahead of us, this program is demonstrating a downward glide slope in this area. In 2019 alone, our negotiating team drove a 9 percent reduction in prime contractor sus-

tainment costs for the U.S. Air Force, directly reducing our overall cost per flying hour.

I am committed to aggressively continuing on this path across all services and partners and to sharing our progress with you as we do it.

My sustainment team and I fully understand that there is no silver bullet in this area and our coordinated and data-informed effort across a wide spectrum of work is required.

For the F-35 enterprise, this coordinated effort is captured in the F-35 life cycle sustainment plan that Ms. Lord mentioned, which is the most execution-friendly sustainment plan I have ever seen.

As a result of the initiatives defined in this plan, as well as the combined efforts of the Joint Program Office, the U.S. services, and industry in executing it, we are seeing meaningful evidence that our targeted initiatives across nine individual lines of effort are improving aircraft availability while simultaneously driving down O&S [operating and support] costs.

We are reducing to aggressively accelerate our software modernization cycles, our supply chain deliveries, and our depot repair capabilities, and to prioritize reliability and maintainability projects so that we have the right return on our investment for our warfighters.

The life cycle sustainment plan also encompasses our path forward for the F-35 Autonomic Logistics Information System, or ALIS, with which you are all familiar.

While we have seen recent improvements in ALIS functionality and responsiveness, significant additional work is required, work that can't be done in old and outdated ways. We must change the way we deliver ALIS capabilities and we must do so now.

In closing, I once again observe that with more than 460 aircraft fielded around the world and delivering combat effects, the F-35 is more affordable and lethal than ever before.

On behalf of the men and women of the F-35 enterprise, you have my commitment to continue to execute this program with the due diligence, engineering excellence, and professional impatience required so that we may develop, deliver, and sustain this fifth-generation air system the warfighter requires on a timeline that makes a difference.

With your help we will continue to bring this game-changing capability to our U.S. and international warfighting partners for decades to come.

Thank you again for this opportunity and I look forward to your questions.

[The prepared statement of General Fick can be found in the Appendix on page 100.]

Mr. GARAMENDI. I thank you, General.

Mr. Behler.

STATEMENT OF HON. ROBERT F. BEHLER, DIRECTOR, OPERATIONAL TEST AND EVALUATION, OFFICE OF THE SECRETARY OF DEFENSE

Mr. BEHLER. Chairman Garamendi, Chairman Norcross, Ranking Member Lamborn, Ranking Member Hartzler, and distinguished members of two committees, thank you very much for inviting me

to join my colleagues today to discuss the status of the F-35 program.

As you know, DOT&E [Director of Operational Test and Evaluation] plays a vital role in the acquisition and fielding process. I have submitted a more detailed statement for the record. But this morning I would like to give you a quick overview of where the F-35 operational testing stands today.

DOT&E, the JSF [Joint Strike Fighter] Operational Test Team, or the JOTT, the F-35 Program Office, the service operational test agencies have been collaborating closely to evaluate the F-35's lethality, survivability, and readiness, and we have been making good progress.

So far, the JOTT has conducted 91 percent of the open-air test missions, actual weapons employment, cybersecurity testing, deployments, and comparison testing with fourth-generation fighters including the congressionally directed comparison test of the F-35A and the A-10C.

IOT&E [initial operational test and evaluation] events have assessed the F-35 across a variety of offensive and defensive roles. Based on the data collected so far, operational suitability of the F-35 fleet remains below service expectations.

In particular, no F-35 variant meets the specified reliability or maintainability metrics. In short, all variants—the aircraft are breaking more often and taking longer to fix.

However, there are several suitability metrics that are showing signs of improvement this year. There are two phases of formal IOT&E remaining. The first is electronic warfare testing against robust surface-to-air threats at the Point Mugu sea range.

The other is testing against a dense, modern, surface and air threats in the Joint Simulation Environment [JSE] at the Naval Air Station Patuxent River.

I will approve the start of these tests when the necessary test infrastructure is ready. The Joint Simulation Environment is essential. The JSE is a man-in-the-loop synthetic environment that uses actual aircraft software.

It is designed to provide a scalable high-fidelity operationally realistic simulation. I would like to emphasize that the JSE will be the only venue available other than actual combat against peer adversaries to adequately evaluate the F-35 due to the inherent limitations of open-air testing.

These limitations do not permit a full and adequate test of the aircraft against the required types and density of modern threat systems including weapons, aircraft, and electronic warfare that are currently fielded by our near-peer adversaries.

Integrating the F-35 into the JSE is a very complex challenge but is required to complete IOT&E which will lead to my final IOT&E report.

The current schedule indicates that the JSE will not be ready to start final phase of operational testing until July of next year.

As you know, most of the IOT&E results are classified. However, I would be happy to provide observations to you and your staff in the appropriate venue.

Again, thank you very much for this opportunity to be here and I look forward to your questions.

[The prepared statement of Mr. Behler can be found in the Appendix on page 115.]

Mr. GARAMENDI. Mr. Behler, thank you. General Fick and Ms. Lord, thank you very much for your testimony.

We have a lot of questioners and each questioner has a lot of questions. So, we are going to try to move expeditiously as we can.

I will attempt to limit myself to 5 minutes as will Mr. Lamborn, Mrs. Hartzler, and Mr. Norcross. So, we will have a go at it.

Spare parts, ALIS, contractor control, depots, and by the way, who runs this program? Joint Program Office or the various services themselves?

Fundamental questions we need to answer. Let us start with ALIS. What are we going to do about it?

Ms. Lord and Mr. Fick—General Fick—what are we going to do here? Are we going to rebuild this entire system? Planes don't run with ALIS not working properly. What are we going to do?

Secretary LORD. ALIS is being dealt with under the framework of our life cycle sustainment plan. One of the things we know we need to do in terms of having adequate sustainment, reaching cost per flight hour, getting the aircraft availability that we need, is to tackle discrete problems. ALIS is one of them.

So, what we have done in the plan is we have actual assignments around ALIS. We have specific individuals responsible for it and dates that they need to meet. The core of what is being done is to rearchitect ALIS. As we continue to patch ALIS as it exists today—and General Fick has a lot of specifics around that—we are making sure that we are transitioning to Agile and DevOps as we have demonstrated the capability to do through the Air Force's Mad Hatter efforts at Kessel Run up in Boston.

What we are doing is rearchitecting ALIS to make sure it meets the needs of the warfighter while making good use of taxpayer dollar and we are working on a detailed plan right now as to when that capability will be delivered.

But we are taking multiple lines of effort that exist today with ALIS and we are coalescing those in 2020 to one effort.

Mr. GARAMENDI. We would like for the record what those multiple lines are—

Secretary LORD. Absolutely.

Mr. GARAMENDI [continuing]. In the detail.

Secretary LORD. And for the LCSP or for ALIS?

Mr. GARAMENDI. Both. But right now, for ALIS.

Secretary LORD. Absolutely. We will certainly get those to you. Absolutely.

[The information referred to was not available at the time of printing.]

Mr. GARAMENDI. Very good.

General Fick, do you want to add?

General FICK. If I could just pile on a little bit. The four individual lines of effort that we are—that have historically been running on ALIS, or what I would characterize as ALIS classic, which is ALIS that was developed as the program evolved, the version in the field right now is ALIS 3.1.1.1.

We are in the process of fielding ALIS 3.5 as we speak. That will bring about 300 stability fixes to that baseline functionality to

allow it to be a better system for the users. That is the legacy system.

At the same time, we have been working on what we called ALIS Next, which was an exploration of new architectures. We have been working on what is called the Mad Hatter initiative, which is an Agile DevOps-focused look at what we do.

Mr. GARAMENDI. So, excuse me for interrupting but I will. The—so we are looking at the—the fundamental architecture is one of my—Mrs. Hartzler said earlier is 20 years old. So, you are looking at a new architecture, in other—a new foundation, a new system, Mad Hatter or whatever it is.

When?

General FICK. So, we are working that transition literally as we speak. We have heavily leveraged Dr. Jeff Boleng, who works for Ms. Lord as the OSD [Office of the Secretary of Defense] software expert. We have leveraged the work of the Boston Consulting Group to terminate further efforts—

Mr. GARAMENDI. ALIS is controlled by Lockheed Martin. Are they working with you? Against you? What is the deal?

General FICK. They are working with us. The fourth line of effort outside of Mad Hatter was IRAD [internal research and development] that Lockheed is doing, and so what we are working to do with Jeff Boleng's help is to coalesce those efforts into a single new version of ALIS marching forward that leverages an underlying data architecture that is expandable with the expanding fleet in ways that the current ALIS is not.

Mr. GARAMENDI. And what is your deadline to achieve this?

General FICK. We believe that we will be able to make significant progress by next fall, by September of 2020. But we are starting movement in that direction right now.

Mr. GARAMENDI. And definition for significant?

General FICK. We hope to be able to turn off select SOUs—squadron operational units—by September of 2020.

Mr. GARAMENDI. And what resources do you need to accomplish this, or can you pry it out of Lockheed?

General FICK. So, we will be looking to work with Lockheed with the—with the group from Kessel Run, the Mad Hatter team, as well as the team at Hill Air Force Base, the 309th software sustainment group, to do that work.

My intent is to do it within existing program funds. But we have not finished our assessment whether additional funds will be needed at this time.

Secretary LORD. If I may just add to that. The Air Force has a high level of competency in software development and we are trying to leverage what we have, particularly at Hill Air Force Base and Warner-Robins, along with Lockheed's capability, to make sure we take the Air Force's experience and success and leverage that on the F-35.

In fact, General Goldfein has specifically asked General Bunch, who is now Commander, Air Force Materiel Command out at Wright-Patt and who I spoke to this morning about this very task, to make sure that he is leveraging all the Air Force has to bear.

I think we need to move forward quickly, and we need to make sure we understand exactly what the maintainers are experiencing, and we need the Air Force's help to do this.

So, this will be a collaboration between the government and Lockheed Martin, and Lockheed Martin—I have spoken directly with Marilyn Hewson about this—is going to need to leverage their software expertise and their best and brightest on this.

Mr. GARAMENDI. A final question from me and then I will turn to my colleagues, who will carry on.

Who has the proprietary information? Who has the rights to the existing ALIS software and architecture?

Secretary LORD. Right now, that is between Lockheed and the government, and one of the key elements of coming up with a new ALIS architecture and software—I am sorry, data standards and all of the other parts that would make a very good system is understanding the entire data set as it exists today, what all the algorithms are and we are still in the process of going through that with Lockheed Martin and we are still having discussions over various parts of that, but understanding where all of the intellectual property is and making sure the government has access to what it has paid for is a key portion of rearchitecting ALIS.

Mr. GARAMENDI. Thank you. Much more to be said about that.

Mr. Lamborn, your turn.

Mr. LAMBORN. Thank you, Mr. Chairman, for having this hearing and I want to follow up on what you just brought up about intellectual property.

Ms. Lord and General Fick, I will ask you this question. Can you give us a little more detail—a little more granularity, if you will—on how we—where we are at now with resolving these intellectual property issues with the prime contractor and do you still have major—any major concerns?

General FICK. So, we still do have concerns. There still are roadblocks as we go to execute everything from as simple as documents that get uploaded into a system and U.S. Government documents that can get uploaded into a system and come back with Lockheed Martin proprietary markings on them.

That is a frustrating occurrence, but it is not one that keeps us from doing work. What we are working to do is to figure out where the places in which those proprietary or intellectual property assertions actually keep us from doing the kind of work that we intend to do.

One of those cases, to Mr. Behler's point, is within the JSE. So, our initial integration of the "F-35 in a Box" into the JSE was held up by a dispute between the government and Lockheed over the intellectual property contained within nine individual algorithms within "F-35 in a Box."

That slowed our progress in getting started and slowed our early progress once we had begun. But that is one specific case in which we identified—

Mr. LAMBORN. And has that one been resolved?

General FICK. So what happened in the case of "F-35 in a Box" is in order to get on contract, in order to start moving forward, we had to sign up to accept less than government purpose rights to be

able to move but reserved the right to challenge that intellectual property assertion.

So, we brought in DCAA [Defense Contract Audit Agency]. They dug through the paperwork, working closely with Lockheed Martin to determine whether Lockheed could prove through their records that those software elements had been exclusively developed at contractor expense.

DCAA could not come to a conclusion based upon the data they were presented and that contracting officer's final determination, or COFD, was that they could not prove that those elements had been developed exclusively at their expense and, therefore, should be government purpose rights.

Lockheed Martin has protested that finding by the contracting officer and elevated that to the Armed Services Board of Contract Appeals for final adjudication and that issue is still being resolved.

So, basically, we are getting to a place where we don't need all the data but the data that we need, it is important that we pursue it. And so, this is the way in which we are looking at what do we need, okay, let us go get it.

Mr. LAMBORN. Thank you.

Ms. Lord, do you have anything to add to that?

Secretary LORD. I think one of the challenges we have is the fact that a lot of the ALIS data and functionality works back through Lockheed Martin computers.

So, what we need to do with our newly architected ALIS is to have that in a government cloud and accessible. So this deconflicting of Lockheed data and the government data will become much clearer.

We also have fundamental standards that we need to set down such as data standards, so it is very, very clear.

Mr. LAMBORN. Okay. Thank you.

And Mr. Behler, you mentioned JSE and you said that you think it is going to be operational for testing in the last quarter of this fiscal year.

Is it on track to meet this requirement?

Mr. BEHLER. Actually, what I said, it would be ready for the physical year next year.

Mr. LAMBORN. Oh, okay.

Mr. BEHLER. So, it would be July of 2020 when we think it will be ready to start operational testing.

Mr. LAMBORN. And that is the last quarter of this fiscal year, but go ahead. Go ahead.

[Laughter.]

Mr. BEHLER. You are absolutely correct, sir.

[Laughter.]

Mr. BEHLER. So——

Mr. LAMBORN. According to staff.

Mr. BEHLER. Yes. So, the question was why is it required?

Mr. LAMBORN. Is it on track to actually be operational by that time?

Mr. BEHLER. Well, that is what the master schedule says, sir, and I guess I am not the program manager and I guess I would ask the program manager if he feels comfortable.

We have been—we have been closely coordinating with the program office and NAVAIR [Naval Air Systems Command] out at Pax River to find out when this thing is going to be ready. There is enormous challenges and there is a lot of unknown unknowns still out there. But I will let General Fick kind of give you what he believes—

Mr. LAMBORN. Yes. Thank you.

General Fick.

General FICK. Sir, so I do believe that the JSE development, the “F-35 in a Box” integration into JSE is on track. The team, led by my tech director behind me, has spent an extraordinary amount of time going through and developing a very detailed line-by-line schedule that looks at that integration.

And to put it in context, we are not only integrating the “F-35 in a Box” into this environment. We are also integrating all of the blue and red threat vehicles, ground systems, airborne systems and weapons, electronic warfare, and all of the things that you need to bring a full 8-on-8 or greater scenario to life in a synthetic environment.

So, to Mr. Behler’s earlier point, this is a—it is a very challenging enterprise that we are trying to actually come as close to combat as we can come without actually putting iron in the sky.

Mr. LAMBORN. Thank you so much.

Mr. Chairman, I yield back.

Mr. GARAMENDI. Thank you, Mr. Lamborn.

Now I will turn to Chairman Norcross.

Mr. NORCROSS. Thank you.

Ms. Lord, in my opening remarks we talked about a defined standardization cost categories and metrics for understanding both the costs per flight hour and costs per tail per year.

We are talking about the F-35 today in particular but this committee deals with many platforms and systems. When we start to deal with legacy issues versus fifth-gen and other systems, apples to apples, the metrics that we are using seem to move. We use certain metrics for one system and different metrics for another. Some of them cross-pollinate.

Talk to me about this issue and how you deal with it and other systems and platforms, but more particular, how can we standardize so that when we are talking about this system’s flight per hour, per cost, is the same measurement as we are doing for other platforms, whether it is the F-18 or any other.

Secretary LORD. We found when we embarked on the 80 percent mission capable journey that Secretary Mattis at the time had set out for us that we were using the same words with different definitions across the services and even between programs.

So, words matter, and we are standardizing how we measure things. When we talk about mission capability it is really the total up-time as safe to fly and capable of at least one tasked mission over the total possess time. So those are aircraft that are with the unit and can be flown.

What we found—

Mr. NORCROSS. Let me just interject a question right there, because we mentioned about the availability rate of the F-35s. They

had two different ratings—one as a single mission capable and then full mission capable. So that goes directly to your question.

Secretary LORD. Yes. So, in terms of air vehicle availability rate, that is defined as total up-time capable of safe to fly plus at least one mission over total active time, which is possessed and non-possessed, which translates to those aircraft that are out of—out of reporting. They could be in a depot, for instance.

So that is the big difference between AVA [air vehicle availability] and MC. It is confusing and I think we need to talk in a little bit clearer terms.

Mr. NORCROSS. But that is just part of it. It is also Lockheed and others who are looking at their sustainment or their O&S costs under one guise and we are talking about another, and the reason I bring that up will go to my next question.

But as we make these decisions, you know, we don't have an unlimited pocketbook to pay for these things and we are trying to make these decisions when they come out.

Secretary LORD. Understood.

Mr. NORCROSS. We need to have standards so we can make accurate decisions on the cost.

Secretary LORD. And if I may make one comment.

We found that we had apples to oranges, as you were saying, types of comparisons. That is one reason that we hired the Boston Consulting Group to look at all the costs in terms of cost per flight hour [CPFH] so that we could understand all the drivers, whether it was direct labor, indirect labor, whether it was repair of repairables, whether it was spares, and on and on and on.

And as we peel back to get to that \$25,000 per hour goal in 2025, we found that we had about \$3,000 per flight hour that we couldn't clearly trace back through Lockheed Martin as to the origin of those costs.

So, we are working closely with Lockheed Martin to understand it and it is the fundamental basis of some of this confusion we have.

So before we get on the path so that we make sure that we are going to achieve that goal with certain steps, we all need to have the same data set, the same fact basis so that we can define our terms, all have the same definition, and then have a plan that we all can trace because up to this point that has been a huge discovery process.

Mr. NORCROSS. Absolutely. Again, just the one issue we saw the F-35, the CPFH, was \$44,000 an hour versus the F-18, \$25,000.

My point is everybody is making decisions hearing these numbers and if we are not comparing one to the other—

Secretary LORD. Exactly. Whether you account for fuel, whether you account for government labor, on and on and on.

Mr. NORCROSS. We have to standardize this, and General, Turkey suspension from the program. We don't expect them to come back. I would like to say that is permanent, but we have some meetings taking place today that—who knows? They had Lot 12. We were going to receive how many? Was it 24 aircraft in those lots?

General FICK. It is 24.

Mr. NORCROSS. Let us talk about the replacement parts, where we are with those and some of the challenges, and then what is going to happen to those 24.

General FICK. Okay. Sir, so there were between Lockheed Martin and Pratt & Whitney 1,005 parts that were single or dual sourced into Turkey and so we began just over a year ago and very quietly but deliberately taking actions to establish alternative sources for all of those parts.

Lockheed and Pratt have been making spectacular progress against that goal, targeting the end of March of 2020 as a time at which we will have alternative sources stood up for all of them.

We are not quite there yet so we have, on the airframe side, about 11 components that still we have yet to fully mitigate to be able to be at full reproduction on those parts by the end of March, and on the engines there is, I believe, one integrally bladed rotors, IBRs.

Mr. NORCROSS. Just a quick followup. For the record, Turkey is still supplying their parts as of today.

General FICK. Yes.

Mr. NORCROSS. Will follow up more on that, but I want to give my colleagues a chance.

General FICK. Sir.

Mr. NORCROSS. Thank you.

Is it a surprise that we are still getting those parts and how long do you expect, or will we continue to buy those as you are setting up an alternative source?

General FICK. So, we are working closely with Ms. Lord and with Lockheed and Pratt to figure out what the most expeditious way is to wean ourself from those parts.

There are a lot of orders still out and parts still in production that will be delivered presently after the end of March.

But what we did not do as we worked to stand up those alternative sources over the course of the last year was to actually dual produce those parts. So, we didn't go and over-produce parts that we had already bought against those Turkish providers.

So what we are working on right now is to figure out what the right laydown is of work orders that might be terminated and work in progress lost or if we can extend the acceptance region to accept those parts and not have to buy duals. That is what we are working closely with—

Mr. NORCROSS. But as of today, the suspension of Turkey is not impacting our parts in any delays so far?

General FICK. Correct.

Secretary LORD. Not at all. In fact, they have been very, very good suppliers.

Mr. NORCROSS. Thank you.

Mr. GARAMENDI. Mr. Norcross, thank you for getting into that. A lot of this is blowing in the wind to today. We will see what comes of all of it with the meeting that is taking place as well as the congressional point of view, which may differ from what the White House point of view is at the end of this day. We will see where we are. Very, very important issues.

Mrs. Hartzler.

Mrs. HARTZLER. Thank you.

Just to keep along the same line of questioning about Turkey, just wanted to follow up. What impact, Ms. Lord, is a yearlong continued resolution? What impact would that have on your trying to find new sources and bring them up to production for these parts?

Secretary LORD. In terms of a CR, it hurts the overall program. But I am not aware of any direct impact on resourcing the parts because Lockheed has—and Pratt have ongoing money to do that. The real challenge is really how we deal with that work in progress that General Fick was talking about and how we make sure we don't waste any of the money already spent on partially built parts.

Mrs. HARTZLER. Very good. Thank you.

I want to shift to cybersecurity, General Fick and Dr. Behler. As I mentioned in my opening remarks, cybersecurity and associated cybersecurity testing of the platform needs to be a high priority.

So, General Fick, could you please outline for us what actions you are taking to ensure the integrity and the security of the F-35 supply chain to include ALIS—[Autonomic] Logistics Information System?

And then, Dr. Behler, could you please provide us with your assessment of the program's test strategy for cybersecurity?

So General Fick.

General FICK. Ma'am, so as we look across the program at all of the elements of the air system from the air vehicle through to ALIS, the training systems and the joint reprogramming environment, we work to make sure that those development efforts are all fully compliant with the RMF [Risk Management Framework] JSIG [Joint Special Access Program Implementation Guide] rules associated with the cybersecurity performance of the system.

So, our development work, our fielding work, is all intended to be full up RMF compliant as we do that work. We do work very closely—our development test team works very closely with the JOTT under Mr. Behler's cognizance to do dedicated cyber testing, to include penetration testing over and above the RMF JSIG test work—development work.

Mrs. HARTZLER. Thank you.

Dr. Behler.

Mr. BEHLER. About the—what we have left in IOT&E, one big portion of that is cyber testing to complete it on the aircraft and on ALIS 3.5. It is very challenging to do it on the aircraft because if we do it on the aircraft, we got to be sure that we can take everything out that we thought—you know, that we put in there.

Right now, we are not sure we can do that. We wouldn't want to put an airplane in the air. We are probably going to do it in an anechoic chamber. You know, we can, you know, do all the stuff we want to do—you know, all the techniques we want to do using RF [radio frequency] signals and all that sort of stuff.

I am glad you asked that question because I am biased a little bit about cyber and software because before coming here, I spent 6 years at Carnegie Mellon Software Engineering Institute and that is all I thought about was cybersecurity.

And if I look at our weapons system today, you know, we have a very good acquisition process to buy hardware and our budgets are based on hardware. But it is really software that makes a difference.

Every weapons system we have today is all about software. It is defined by software—not enabled but defined. Without software, boats don't leave the pier, airplanes don't fly, et cetera.

We need to do better in cyber testing, and this is not putting more money into the problem. This is about intellect. We need to get the A Team on the DOD side to help us do cybersecurity.

But as we—for this particular program we are going to do much of what General Fick said about penetration testing and adversarial assessment.

But I will caveat this saying that we do not have all the tools that the adversary has to do the adversarial assessments. That is where the intellect comes in. We need to do better.

Mrs. HARTZLER. On a scale of 1 to 10 with 10 being the highest threat, the planes that are flying right now, where would you put us at—the cybersecurity of our current operating planes? Or maybe you want to answer it in—

Mr. BEHLER. Well, I think that is a very difficult question to ask. You know, it is—

Mrs. HARTZLER. If you are still testing—

Mr. BEHLER. We are still testing, and we need to continue the testing. Every day we find another vulnerability and I will also say this is a very complex program both in ALIS and the aircraft. Millions of lines of software code.

The more code you have, the more complex. The more complex, the more vulnerabilities. We need to figure out a better way to write programs for our weapons systems, to write less software rather than more software.

Mrs. HARTZLER. Okay.

General Fick.

General FICK. Ma'am, I will add, as we talk about—specifically about ALIS and about moving to modern code-based lines and modern code architectures, one of the fantastic steps that the Air Force did in terms of moving ahead with their Mad Hatter and Kessel Run team is they are changing the way they think about accreditation and certification of software and they are making it so that it is designed and not patched on.

They are exploring new ways to have—to basically accredit the development environment so that software that is developed within that environment comes out cyber secure and that is not something you think about after you have actually put the software elements in place.

So, to Mr. Behler's point, bringing the right minds to think about it from a modern software construct perspective makes a lot of difference.

Mrs. HARTZLER. It makes a lot of sense. Final comment?

Mr. BEHLER. If I could just add one very small part. You know, if we look at what we are able to do today in software testing, we are in the lower left-hand corner doing our work. The adversary is in the upper right-hand corner. It is the junior varsity playing the NFL and we got to do better.

Mrs. HARTZLER. On that positive note, I yield back.

Thank you.

Mr. GARAMENDI. I want to thank our four colleagues for raising some critical issues with regard to the software. This committee—

we really are supposed to be out of this room at 12:30 so it can be swept for security, and guess what the next committee hearing is?

It is on the subject of software, G5, or 5G, rather, and we are going to go right back into it with the next committee hearing. Maybe we can all stick around and learn something.

Mr. Courtney, you are next.

Mr. COURTNEY. Thank you, Mr. Chairman. Thank you to the witnesses that are here today.

When the F-35 decision was made to go to single engine, one of the biggest driving factors was the Navy's adamant testimony. CNO [Chief of Naval Operations] Roughead pointed out that having a dual engine system and trying to find the space on carriers and amphibious ships would be almost impossible.

So I would like to focus, Lieutenant General, just for a minute on the afloat spare package issue, which represents one of the four types of parts packages for supporting the F-35 in different environments.

It is unique, however, in its space and maintainer limitations given that the package must provide the necessary parts to sustain F-35s on a ship while competing for space with all the other materials a carrier or amphibious vessel must carry while on deployment.

So I am going to ask two questions and then let you run with it. In working with the Navy to develop the requirements for the afloat spares package, what kind of obstacles either from a fiscal or practical standpoint have you encountered and what adjustments have been made?

And secondly, what has the program learned from early deployment such as the USS *Essex* and how do you anticipate challenges will evolve as the B and C variant are increasingly embarked on carriers and amphibious vessels? Are there specific parts or components such as the stealth canopy that present particular challenges to the afloat environment?

General FICK. Sir, thank you for your question. Very insightful and very meaningful.

As we look at the afloat spares package, much like the deployable spares package that goes with land-based units that go into combat, what is important is that you marry up that package with the pedigree of the aircraft that you deploy forward.

As we look at early deployments of As, Bs, and Cs, we, in some cases, had a wide mix of aircraft from different LRIPs—low-rate initial production lots—which means that in some ways you may end up with a deployed or an afloat spares package that has parts for a lot that may or may not actually be in your squadron anymore.

So, the notion that you can have an afloat spares package that you buy once and you only check when you buy it and you never look at it again, we need to throw that notion out the window.

My team is working very close with Dan Frye, my product support manager right behind me, to do reviews on the DSPs [deployment spares packages] and ASPs [afloat spares packages] on no less than an annual basis but also in terms of as they prepare for spin-ups, for deployments, to look at the kits to make sure that the

kits onboard the ship reflect the configuration of the aircraft that are brought onboard. It is absolutely essential to making this work.

Relative to problem parts, you mentioned the canopy. Right now, the canopy is our current top mission capability rate degrader. From over the course of the last 6 months, I think it has averaged about 5 percent of our NMCS—non-mission capable for spares—as associated with the canopy.

I wouldn't necessarily characterize that as a B model or a C model issue as much as I would characterize it as a fleet issue. In fact, the Bs particularly have seen fewer canopy issues than the A models have thus far.

Mr. COURTNEY. When you have deployments on the *Essex*, I mean, any sort of early feedback?

General FICK. So just reinforcing your point, sir, that making sure that the ASP matches the aircraft that are on board is critical. There may be one or two others.

One of the things that we have noticed as we integrate this air system into the supporting infrastructure both on land and at sea is that we have got to get the comms right.

And so, in a couple of cases, as we have deployed aboard these amphibious craft we have noticed that data, for instance, that ALIS is attempting to transmit off board is transmitting much, much slower than we would otherwise have thought it would.

What has happened in both cases so far on two previous deployments has been that router switch settings and basic network configuration issues prevented the transmittal of data at appropriate rates to allow us to operate the aircraft in the sense that we need to.

So, we need to do better at helping those who we are boarding ALIS with to actually understand what those settings need to be, understand what those configurations need to be.

So it is not a matter of trying to invent how we integrate ALIS into a ship each time. It is a matter of just plugging it in and going.

Mr. GARAMENDI. Thank you, Mr. Courtney.

It is interesting we keep coming back to ALIS.

Mr. Wilson.

Mr. WILSON. Thank you, Chairman Garamendi, and my son, Hunter, sends you greetings. And South Carolina—and I thank all of you for being here—but South Carolina is grateful. F-35s have been warmly welcome at Marine Corps Air Station Beaufort and we would like to welcome F-35s to the Joint Air Base McEntire at Eastover, South Carolina. Colonel Ghandi would be very happy to be right on the flight line to wave you in, and we would really appreciate the service.

And Secretary Lord, Fleet Readiness Center [FRC] East is the largest industrial depot that generates combat air power for both the Marine Corps and Navy variants of the F-35. The infrastructure of FRC East continues to lag in upgrades and new construction commitment from the Navy.

The problem of antiquated legacy maintenance facilities is particularly acute in the Navy and how is the Joint Program Office, the Navy, and Marine Corps to ensure that we continue to commit

resources to the right efforts to improve FRC East in their maintenance performance?

Secretary LORD. We are looking at the capability of 68 actual depot repair lines. We only have 30 of 68 up and going right now and we have committed to accelerate those to have them all completed by 2024, and it comes down to a number of items.

It is getting equipment. It is getting tooling. It is getting the actual repair information out there. So what we have done is come up under our LCSP with a plan to do that and we are going back and working with Lockheed Martin and Pratt on each of these.

But we are working down line by line on those and we meet monthly with both—all of the services to talk about the progress that is being made.

Mr. WILSON. That is very encouraging, and we appreciate your service.

And General Fick, the F-35 program does not maintain a war reserve materiel stock of F-35 engines, unlike other tactical aircraft programs.

Was that a deliberate decision within the program to not maintain a war reserve materiel stock of engines and, if so, how will this risk be mitigated by not having war reserve stock during major contingencies?

General FICK. So, sir, a program decision was made early on. I don't know exactly the date, but a program decision was made to spare modules instead of sparing engines, which presupposes then that you can take a module and insert it into an engine that requires a new, you know, compressor or turbine or burner module.

The program is working closely with the services today to reassess whether that is the right approach or not. In most cases, as we have deployed forward, we have ended up taking spare engines with us despite the initial plan to take modules from a sparing perspective.

That decision, I understand, was made for cost reasons. Much more cost effective to spare a module than an engine. But if you can't install the module in the engine then it isn't very much used, too.

So, we are exploring—in light of recent deployments we are exploring whether that construct still makes sense today.

Mr. WILSON. Well, thank you very much. Again, your service is so critical, and we have faith in your leadership.

And Ms. Maurer, at the end of 2022 the F-35 worldwide fleet is expected to double from approximately 488 aircraft to 985.

How will the sustainment enterprise keep pace with the expanding fleet and need for additional parts? What is the Department of Defense doing over the next 3 years to increase depot repair capacity?

Ms. MAURER. Well, I think the first thing I hope that they are doing is implementing all 21 of our recommendations that we have made to them over the course of many years to help enhance sustainment of the program.

Specific to the depot, we do know that the Department has made important progress in enhancing the depot capabilities, but they are 8 years behind their initial plans for doing so.

Mr. WILSON. Well, we need your cheerful encouragement that we come up to date.

And Secretary Lord, what is the service responsibility for funding the needed construction and modernization, again, at FRC East? Is it Navy or Marine Corps?

Secretary LORD. I would defer to General Fick on that. I am not sure.

General FICK. Sir, I am going to have to take that question for the record. I am not—I am not up to speed relative to what needs to happen from a facilitization perspective specifically at FRC East.

But what I can tell you is, to Ms. Lord's previous point, is that we have now 68 planned workloads on contract with Lockheed Martin to actually stand those up from an organic depot perspective to include, as I understand it, capabilities to be stood up at FRC East.

Mr. WILSON. Thank you very much. I look forward to getting a full and complete response and thank each of you for your service.

[The information referred to was not available at the time of printing.]

Mr. GARAMENDI. I want to compliment my colleagues here on raising critical questions. The FRC, otherwise known as depots, the sustainment is not coordinated with the purchases of new airplanes.

You are headed into a situation where we are going to have 1,100 planes and we will not have the ability to maintain them.

And so, the readiness is going to decline. The question that I am going to be pursuing in the months ahead is can we wait until 2024 to have half of the—to have the depots operating at half of the potential or half of what they need.

The answer is no, we cannot wait unless we want a bunch of airplanes sitting, unable to fly. And this is the sustainment issue. This is the ALIS issue. This is also the spare parts issue—all of those things.

Fact of the matter is this program has not paid attention to sustainment and it will from here on out. I will have you over here every week having another discussion about it.

Ms. Maurer, you have listened to the testimony thus far. I would love to be asking you on every question that we asked Ms. Lord and General Fick and Mr. Behler, to comment on that. But I am well beyond my time.

I am now going to turn to Mr. Carbajal.

Mr. CARBAJAL. Thank you, Mr. Chair.

Ms. Lord and Lieutenant General Fick, in the GAO's sustainment report issued this past April 2019, you provided a recommendation for the Department to develop an intellectual property, or IP, strategy that includes identification of all critical technical needs and associated costs.

The report states that DOD concurred with the recommendations but has not yet implemented it, and also that DOD's inability to obtain intellectual property and technical data from the contractor is an issue across the entire F-35 supply chain.

Can you please provide an update on the DOD's implementation of an intellectual property strategy and what challenges remain in obtaining the necessary technical data and IP from industry part-

ners to better address supply chain deficiencies and bring down costs?

Secretary LORD. We are doing a fundamental rewrite of all of our acquisition policy this year and we are concurrently reworking the entire curriculum at the Defense Acquisition University to make sure our acquisition professionals have the ability to really understand what is out there in policy.

Our policy in the past has been very legalistic, I would say, and what we have done is decomposed it into what I call the adaptive acquisition framework with a variety of different acquisition authorities explained that Congress has given us over the last 5 years or so, along with contract types that should be used.

One of the critical components of this is understanding intellectual property, so we actually have an intellectual property policy that is just about to be released where we worked closely with the Army, who began at the forefront of this.

And what we are fundamentally saying is before we put together an acquisition strategy you have to think about what information is critical to a program, particularly in terms of sustainability, so you are not always held hostage to the prime on that through the life of the contract and that you can find better cost solutions through a variety of different providers.

So we provide direction, asking the acquisition professionals to think about what is the information, the intellectual property that you need and that you don't need, and to make sure that is clearly articulated in the request for a proposal and then is addressed during contract negotiations because, frankly, if that was thought through at the beginning of programs you would not be where we are in the F-35 program today where the intellectual property is an afterthought and we are having to wrestle it as we go through each contract.

So, it is core and fundamental to what we are doing. When we are training acquisition professionals now, versus kind of locking them down at Fort Belvoir usually for 8 or 12 weeks and learning, we are moving from sort of a transmit mostly mode of instructors to really doing adult learning where it is experiential learning where we have actual operators coming in and explaining what their experience has been on programs, have people live through the life of what they learned during particularly problematical acquisitions—mistakes they made and so forth.

So, it is right at the forefront and I think you will see a lot coming out on that shortly.

Mr. CARBAJAL. Thank you.

Lieutenant General Fick.

General FICK. Sir, I think Ms. Lord hit most of it. What I would go back to is the notion of—if I were to encapsulate our strategy in broad—in broad strokes, I would say it is to pursue the data that we need and only that data.

Back in the beginning of this program as it was stood up as a TSPR program—a total system performance responsibility program—with Lockheed Martin in charge we didn't think about those data elements because we didn't think we would ever need them.

So now what we are doing is, to Ms. Lord's point, putting those data elements on contract every time we need them delivered and

in cases where the intellectual property issues get in our way, such as the “F-35 in a Box” issue we discussed earlier, we are actively challenging them.

One of the things as we talked about the standup of those organic depots is it is critical that the data that enables us to do that work is delivered as we work to stand up those organic capabilities, and that is a great success story.

As we have worked through those 60 of 68 items on contract now, each of those come with the data required to allow the organic workers, be they Air Force or Navy, to do that—to do that work.

So we are making progress, but it is a broad problem.

Mr. CARBAJAL. Thank you. And I only have a few seconds left.

Ms. Maurer, are you aware of any other weapons system with similar supply chain problems from the lack of cost data or intellectual property from contractors?

Ms. MAURER. You know, the F-35 program is unique in many aspects from the way it was first created and developed—the fact that it is an international program, the extent of the involvement of the prime contractor.

And I would say, unfortunately, that the nature of the problems facing the F-35 program from the sustainment perspective are also unique.

Just real quickly on the international property or intellectual property issue, that was an issue we flagged in a report in 2014 and we are quite pleased to see that the DOD is making progress in addressing it.

But I really encourage you and the other members of the committee to pay close attention to that because I completely agree with Mr. Behler’s comment earlier that weapons systems today are essentially flying or sailing or moving pieces of software, and the intellectual property is an important piece of that.

Mr. CARBAJAL. Thank you very much.

Mr. Chair, I yield back.

Mr. GARAMENDI. Mr. Carbajal, thank you for raising that issue and thank you for calling on Ms. Maurer. I would like to make that a standard procedure.

Mr. Bacon, you are next.

Mr. BACON. Thank you for being here and for your leadership on an important program.

Ms. Lord and General Fick, I would just like to get a real clear opinion from you and impression. What will a continuing resolution, particularly if it goes into the next year—what will be the impacts on the F-35 program?

General FICK. Sure. From a—from an F-35 perspective, what I look at are, basically, three areas. My ongoing development activities, specifically, the development associated with the generation of modifications to the platform was a new start in 2020 and so those efforts will not be able to continue.

One of those new start mod efforts was DCA, our dual-capable aircraft—critical capability. That is very, very important to us that we get that. That is thing one.

Thing two I would characterize is we have actually a plus-up of C model production from 2018 to 2019. We will be held at 2019 quantities if we are unable to get a budget in this year.

And then the final thing I would add is that we also, thank you very much, had EOQ [economic order quantity] as part of this budget and that will help us to continue to drive production costs down in Lots 15 and beyond.

So, if we don't get that—it is, roughly, half a—\$500 million or so—if we don't get that, that will delay our ability to start that work and the effectiveness of EOQ and production.

Mr. BACON. Ms. Lord.

Secretary LORD. So General Fick gave you many specifics. I will tell you if we have a CR, we continue to have to rearrange work to not be able to move forward.

So there is an enormous amount of administrative time that is really non-value added that goes to that and we have to continue to think ahead about what is the next impact. So the EOQs—the economic order quantities—for instance, we are always trying to figure out where those economies of scale are and how to best work that. We can't do that if we don't know when we are getting the money.

Mr. BACON. Okay. Thank you.

I think it is important that Congress realizes there is impacts across the entire enterprise with a continuing resolution and we owe it to you and the F-35 program here to get our house in order.

General Goldfein calls the F-35 the quarterback of, you know, the battlespace because it can receive all this data, fuse it, and disseminate it.

I have been concerned for years that we don't—that we are not going to get this right—that we want to ensure that the fifth-generation aircraft are getting this data, but more importantly, the fourth-generation and, hopefully, we can get the data back to the air operations center. So while the F-35 is still over the battle site, the next sorties that are taking off have the current battlespace data so that we can be more effective, save lives, and get the job done more effectively.

How are we doing on this fusing of the data and transmitting of the data? So, really, I think this is probably mainly for General Fick but if others—anybody else has any feedback I will appreciate it.

Mr. BEHLER. Yes, sir. That is a terrific question. We have—we have been doing operational testing with fourth and fifth gen together and what we are finding is the combination we are having a more lethal and more survivable force.

The F-35 as the quarterback, like General Goldfein likes to say, is absolutely correct. You know, a stealth airplane has some challenges with how much weapons they can hold because you want it all internal to keep yourself real stealthy and low-observable.

So you need a truck that carries weapons for you and we have found that, you know, you put the F-35 with the A-10, which we did some—a lot of close air support—the combination of those two weapons together really provides a capability that we have never had before.

F-35 with the F-15—with the F-15 and then the future EX F-15—it will be just a big truck carrying weapons out in front of the F-35 doing the defensive and offensive counter air, and the com-

munication will be—right now will be with a Link 16. But we hope that we will get better combinations of—

Mr. BACON. How are we doing at getting—thank you for that, because being a 30-year Air Force guy myself, I am totally with you on this. So, I mean, we want to make sure that we optimize this and take advantage of it.

How are we doing getting the data back to the air operations center? Because that is really sort of a concern that I have not heard that we have really solved this because what we want to do is as the F-35s are leading the fight, the next wave has the data and also that our joint force is getting the data and so we can disseminate where the tanks—the enemy tanks are at, where the enemy S-300s could be, you know, and so forth.

Mr. BEHLER. Right. Exchanging that information with the fleet, with the AOC [air operations center], with the tankers, is all critical to this mission, especially when you are flying a high-density, high-threat environment.

Right now, the data from the F-35 to the AOC is not as good as it should be. I mean, you almost feel like there ought to be an ALIS terminal in the AOC to gather that information real time or having software—defined radios and—but we are not real-time enough, but we need to do that.

And going forward in the future, the AOC—I mean, it is one of those things that technology begets doctrine, not doctrine begets technology.

We have more capability in the F-35 than we have ever had in any other airplane; data fusion and the ability to understand the full situation we are in is one of them. That needs to be disseminated to the rest of the wings that are out there flying.

The AOC is important, but I think it is more important to get the information out to the other warfighters and especially the tankers, too.

Mr. BACON. Thank you, Mr. Chairman.

Mr. GARAMENDI. Thank you.

Mr. Brown.

Mr. BROWN. Thank you, Mr. Chairman.

Let me thank both chairs and both ranking members for convening this hearing today on the sustainment, production, affordability challenges of the F-35. A lot of hearings happening on Capitol Hill today.

I think this is one of the most important not only today but in the 116th Congress. I say that because the F-35 is the most expensive program in the history of the Department and arguably one of the most complex acquisition, production, and sustainment programs.

So, I want to thank the chairs. I also want to thank the professional staff members on HASC [House Armed Services Committee] for assisting Congress through your arduous and diligent effort engaging the Department and industry so that we understand this program and we can fulfill our congressional oversight role.

We have heard about insufficient spare parts. We have heard that the Autonomic Logistics Information [System] known as ALIS is struggling.

Mr. Behler, you mentioned that aircraft are breaking more often and taking longer to fix, and while General Fick, in your short tenure you are observing or seeing progress, I think Secretary Lord probably captured what most of us understand and appreciate, that much work remains.

So, I am going to indulge the chairman, Chairman Garamendi, and start with a question with Ms. Maurer from the GAO, our watchdog. I value tremendously the work that you do, the work that your colleagues do, and the recommendations that you make.

So, you mentioned that there were 21 recommendations. You said that DOD agrees with most, so I assume there is one or more that they don't agree with.

So, could you please either identify the most significant recommendation that DOD does not agree with? And then, Ms. Lord, if you could kind of respond so I can have a little bit of back and forth, and to the extent that DOD does agree with all of them, which recommendation are—concerns you most in terms of the rate at which they are implementing that recommendation, and then perhaps Ms. Lord could respond.

Thank you.

Ms. MAURER. Sure. Well, first off, thank you very much. It is a privilege and honor to spend my professional career at GAO and serving the Congress and the taxpayer, so thank you.

In terms of our recommendations, DOD has concurred with a vast majority of them. The relative handful—and we are talking about 3 or 4 out of the 21—are related to the issue of cost assessment.

A lot of that dates back to some of our prior work and GAO and the Department basically have a philosophical difference of views on how robust cost assessments and cost estimates should be and the extent of—extent to which you build flexibility or a variation around the future cost estimates, whether you have a point or whether you have a range, and I think a lot of the differences are around that point.

Secretary LORD. This really gets to the nature of the types of systems that we are developing today. They are hardware enabled but software defined. We also have an adversary who is rapidly changing what they are doing.

So, we have overall requirements but we want to maintain a very flexible requirement level to some degree to be able to respond to that. We also want to make sure that in the software-defined environment we are able to really take advantage of DevOps in terms of coding software.

So, essentially, we are developing, producing, and sustaining software all at the same time, running testing every night. We talked about having cloud environments where we have—

Mr. BROWN. Okay. Let me just do this. I think I have the call of your response. What is your response, Ms. Maurer?

Ms. MAURER. So in terms of the recommendations that we think are most important, we had a couple of recommendations in a report that we did this year as well as one that was issued about a year and a half ago that asked the Department, or the program more specifically, to look fundamentally at the structure of the

overall approach to sustainment as well as the approach to a supply chain.

We found and we were very concerned about the fact that over a period of many years the Department had been incremental and reactive in its approach to these critical issues.

We have started to see the Department getting traction on some of those. But frankly, there is a long way to go. There are a lot of important details that have not—

Mr. BROWN. And could you just—in the last 30 seconds I have can you give us a sense of what that does in terms of the sustainment, production, and affordability?

Ms. MAURER. Well, for example, one of the key things that has not been worked out is the movement of spare parts around the global supply pool, right. That means we have to—the contractor has to move parts between the U.S. services and the partners.

That requires a number of specific trade agreements to move the parts from country A to country B. Those have not all been negotiated. That slows down the ability to move parts and it affects the overall ability to sustain the system in the field.

Mr. BROWN. Thank you. I wish I had more time.

Will there be a second round, Mr. Chairman?

Mr. GARAMENDI. No, there will not be a second round.

Mr. BROWN. Okay.

Mr. GARAMENDI. We will move to the contractors—

Mr. BROWN. Okay.

Mr. GARAMENDI [continuing]. And you may want to ask them that question.

Mr. BROWN. Thank you, Mr. Chairman. Thank you.

Mr. GARAMENDI. Mr. Wittman.

Mr. WITTMAN. Thank you, Mr. Chairman.

I would like to thank our witnesses for joining us today.

Mr. Behler, I would like to begin with you. We have had a lot of information given back to us about the ALIS system. We all know how it is designed to work, taking lots of data in, using that to integrate that, make sustainment choices.

We have heard about the challenges with software, how the system is supposed to operate versus how it does operate, what happens with sustainment issues, supply chain, all those kinds of things.

But what I want to ask is if we get all those problems fixed it still seems like to me that there is indeed a challenge because that system relies on with the F-35 being able to communicate—give that information back and forth.

And we know that if we find ourselves in a contested environment, comms are going to be denied. So then the question becomes is what happens to ALIS in a comms-denied environment or what we are doing to really channel comms.

As you know, there are a lot of different things that we do to manage that under an EMCON [emissions control] condition. Give me your perspective on how does ALIS function within that environment, especially if it is over a long period of time.

Mr. BEHLER. Right. So that is a question we have been asking for a while. We have actually taken aircraft to austere locations and operated them for an extended period of time to see if we can

do exactly what you are suggesting to be able to and the exact days that it can go without refeeding the ALIS into the connected back to Fort Worth, you know, that is to be determined.

We really don't know that yet. But you bring up some really important points. You know, in a comms-denied environment how do we do command and control of just the air warfare but not having access to ALIS.

When we were out on the aircraft carrier the *Abraham Lincoln* to watch the sortie generation there, it is kind of an austere location when you think about it. The biggest challenge with ALIS of getting the information of the aircraft into the current system on the carrier which had—all the ALIS modules had to be brought out there and it just ran out of room because there was so much space required and so much—you know, the heating requirements, electrical requirements.

So that is going to be something that we are going to have to do more investigation on and we will be definitely writing that in our—in our final report.

Mr. WITTMAN. It seems like the problems that you point out now—software, sustainment issues, supply chain—potentially could be exacerbated if you are operating in a comms-denied environment.

So I hope that you all look very carefully at that because, to me, that seems like the largest strategic question that we are going to have to address and there may not be as direct an answer to it as a software issue and the other operational issues that have been pointed out.

Mr. BEHLER. Yes. They are an enormous challenge. I will leave you with one point. I believe that information is like ammunition.

Mr. WITTMAN. Yes.

Mr. BEHLER. It needs to be in the hands of the warfighter.

Mr. WITTMAN. Exactly.

Mr. BEHLER. It doesn't need to be back in some central location. It has got to be right where it needs to be, like at the squadron-level ALIS system in an operational environment.

Mr. WITTMAN. Lieutenant General Fick, let me get you to drill down a little bit on that. We know that our large-deck amphib ships are the operating platform for the F-35 Bravo. That variant has proven to be a game changer for the Marine Corps.

But what happens with that is that that aircraft is able to gather so much information and our large-deck amphibships, unfortunately, don't have the ability to take that information in in real time so the C2 [command and control] capabilities there then are very, very limited.

So, tell me your perspective on what do we do to get the full power capability of the JSF, the F-35 Bravo, through our Navy's large-deck amphibships?

To me, there is a limiting factor there. It is not just the structural issues of the heat on the deck and reinforcing the deck but it is—you know, what are we doing to be able to get that information in real time and utilize it in ways that are tactically important to the warfighter?

General FICK. Sir, thank you for the question.

First, if I can go back to the previous one. We do carry a requirement to do disconnected ops for 30 days with ALIS in its current instantiation, and as we work to rearchitect ALIS and to look at what the requirements as we march forward from both a data architecture and a hardware architecture perspective, we need to examine that requirement to operate in austere locations so that we get the right system built in to be able to accommodate that.

Relative to the big-deck amphibs, we have had cases over the course of the last 12 months in which ALIS data specifically was choked coming off the—coming off the platform.

In each of those cases, I understand that it was basic network settings that some combination of we not communicating properly with the ship's company or them not communicating properly with the F-35 folks onboard prevented us from getting the network set up in a way that enabled that communication to happen.

So, I think two things need to happen as we march forward. One is we need to look at what is the bare minimum amount of data that has to flow in this new architecture to allow us to do the things we need to do on the ship. So we minimize the demand for that pipe.

Then the second part, sir, is to make sure that when it comes to instantiating ALIS aboard those big-deck amphibs or at those austere basing locations that we actually have a very, very well-defined installation process so that we don't have to discover these things again.

Mr. WITTMAN. Very good.

Thank you, Mr. Chairman.

Mr. GARAMENDI. Thank you for your question.

We are not doing a second round of questions but in deference to my chair, co-chair, Mr. Norcross does have another set of questions that he would like to get on the record.

Mr. NORCROSS. Just a quick followup, General, dealing with the Turkey question. They had 24 aircraft in the most recent contract award. How do you mitigate that issue to preserve the unit price for the contract, taking those 24 into consideration?

General FICK. Sure. So what we did to maintain both the flow and the overall quantity as we—as we worked very, very closely with Lockheed Martin because we had already been a handshake before this Turkey removal happened.

We work closely with Lockheed, my negotiating team, and the Air Force, I would add, because what we were able to do is to slide congressional plus-ups from U.S. Air Force A's into those positions in the production line to allow the U.S. Air Force then to take possession of those aircraft as they flow off. So that the eight Turkish designated—

Mr. NORCROSS. When you say the plus-ups, the potential plus-ups that we are talking about?

General FICK. From Lots 12 and 13 specifically.

Mr. NORCROSS. Okay.

General FICK. And then looking at potential plus-ups in 14 to take care of the 8 Turkish F-35As in Lot 12, the 8 Turkish F-35As in Lot 13 and then also in Lot 14.

Mr. NORCROSS. And they have two more production aircrafts.

So, we are adding those in anticipation of O&S that is now running out of control and we are not handling those F-35s that are coming off the line now and we are talking about adding 24 in a more expedited role. How do you plan to handle that cost? Those 24 are coming in quicker——

General FICK. Yes.

Mr. NORCROSS [continuing]. Than we had planned for, correct? So, the O&S side of that equation is now being pushed forward. How are you addressing that——

General FICK. Being accelerated? So, these aircraft were——sir, I guess I would like to come back to you with a more complete answer. Ultimately, those aircraft were intended to be purchased by the Air Force in Lots 12 and 13 and 14 anyway. They are just being accelerated by a number of months forward.

Mr. NORCROSS. We understand what you are saying.

General FICK. Okay.

Mr. NORCROSS. It is not the acquisition costs.

General FICK. It's sustainment. Right.

Mr. NORCROSS. It's how do we accelerate the costs of maintaining and those O&S.

General FICK. Yes.

Mr. NORCROSS. Ms. Lord, just quickly, do you have anything to add to that?

Secretary LORD. Just that we are trying to work with the economies of scale here to our benefit as we work forward——

Mr. NORCROSS. For the purchase price, absolutely. But——

Secretary LORD. No. No. No. But as we also work forward on sustainment contracts we are doing the same type of thing where we are looking at the costs very carefully and making sure that the indirect costs associated with the direct costs are coming down so that we get those and making sure that we structure all the contractual agreements so that they do have incentive fees that have to be earned versus fees that go along with that.

Mr. NORCROSS. The point we are trying to make here, and I think it is across the board, is that the sustainment costs are a major issue. I think the acquisition costs are going relatively well, if not good.

But when we push or accelerate those planes into the sustainment side of the equation earlier, we are not prepared for them.

So, I yield back.

Mr. GARAMENDI. I thank you, Mr. Norcross. That is the fundamental point we have been raising throughout this entire hearing.

We are going to have to move on now to the industry—Lockheed Martin and Pratt & Whitney. Thank you. I was just about to ask another question of the current panel, but I am going to not do so.

I would like—if you are—I am sure the current panel has other appointments—would like to get to them. But perhaps your staffs can stick around, if they would do so.

All too often I have seen the first panel head out the door when they should be here to listen to what others have to say.

So, thank you very much for that. Thank you very much.

Here is what we are going to do. We are talking about \$1.4 trillion over the next 20 years or so. That will be taxpayer money spent on what most people consider to be the most important ele-

ment of the air battles that may take place in the future and we got a big problem here. This thing is not working well and in many cases is not working at all.

And so, we are going to have another opportunity to speak to the four of you in early January, and we may do it in a closed hearing. We are likely to do it in a closed hearing. So, enjoy the holidays.

[Laughter.]

Mr. GARAMENDI. Thank you very much. Appreciate your testimony.

We are going to now move to the second panel. We are going to take a short break, no more than 5 minutes, as people move and to reassemble themselves.

So, thank you.

[Brief recess.]

Mr. GARAMENDI. Begin our second panel now, and we have two witnesses.

Mr. Greg Ulmer, vice president and general manager of the F-35 program for Lockheed Martin, and Matthew Bromberg, president of Military Engines at Pratt & Whitney.

So, Mr. Ulmer, if you would like to start. You were here to listen to the previous panel.

Mr. ULMER. I was.

Mr. GARAMENDI. So, start wherever you want and then we will have our turn.

**STATEMENT OF GREGORY M. ULMER, VICE PRESIDENT AND
GENERAL MANAGER, F-35 PROGRAM, LOCKHEED MARTIN
CORPORATION**

Mr. ULMER. Thank you, Chairman.

Chairman Norcross, Chairman Garamendi, Ranking Member Hartzler, Ranking Member Lamborn, distinguished members of the committee, I appreciate this opportunity to testify on behalf of Lockheed Martin and the F-35 II—Lightning II industry team.

I thank you for your support and your continued partnership in advancing this critical program and for your steadfast support of our men and women in uniform.

Before I take your questions today, I would like to provide a brief update on the F-35 program from industry's perspective.

While we continue to face challenges, there is no doubt the program is beginning to hit its stride and we will continue to work with the services, the Joint Program Office, our international partners, and Congress to ensure the program remains on track.

I have submitted my full statement to the committee, which I ask be made part of the hearing record at this time.

The F-35 stealth technology, supersonic speed, advanced sensors, weapons capacity, and increased range make it the most lethal, survivable, and connected aircraft operating in the world today, and with more than 455 aircraft now deployed on operational missions and conducting advanced training exercises, we are seeing users deploy the aircraft and weapons system beyond what was ever first envisioned.

F-35s now operate from 20 bases, 3 ships, and 9 countries operating aircraft on their own home soil. The F-35 has and is transforming coalition operations today.

The F-35 is also empowering economic growth. The program has 1,500 Tier I suppliers with more than 1,400 of those in the United States, spanning 45 States and Puerto Rico, and supports more than 220,000 direct and indirect jobs.

In the United States alone the economic impact is more than \$44 billion annually.

The industry team is ready for full-rate production. Our plan is to deliver 131 aircraft this year. Currently, we are delivering at a rate of 12 aircraft per month, which positions us to meet next year's aircraft delivery rate of more than 140 aircraft, and we have additional capacity to accommodate increased production rates atop of that.

Lockheed Martin and the U.S. Government recently announced the agreement for Lots 12 through 14 contract, which achieved the shared government and industry challenge of delivering a less than \$80 million aircraft 1 year earlier than originally planned and reduced costs on all 3 variants by an average of 12.7 percent.

As operational deployments continue to increase, we are keenly focused on the need to reduce sustainment costs and improve mission readiness. We believe with the same disciplined approach we can deliver cost reductions similar to those that we have realized in production.

Sustainment costs will continue to decrease as operational lessons learned are implemented, data-informed predictive health monitoring improves, spares parts availability increases, and a more robust repair capacity is realized within our military depots and across the original equipment manufacturers.

We firmly believe a 5-year performance-based logistics contract structure coupled with \$1.5 billion in advanced funding from Lockheed Martin will provide stability and funding needed to accelerate cost savings and improve readiness rates for the F-35 while allowing the program to operate within its existing budget today.

Today, we are developing and leveraging and integrating new technology to ensure the F-35 stays ahead of ever-evolving threats while widening the gap over fourth-generation aircraft.

In conclusion, we are on a positive glide path with the F-35 and we are quickly solidifying its role as the backbone of fighter fleets of our nation and well—those as well of our closest allies.

On behalf of the men and women of Lockheed Martin, we thank those in uniform and their families for all that they do today and every day to keep us safe, and we appreciate the critical role Congress plays to ensure our warfighters ready to succeed on the battlefields of not only today but of tomorrow.

I thank you for this opportunity and your strong support for the F-35 and I stand ready to answer your questions.

Thank you.

[The prepared statement of Mr. Ulmer can be found in the Appendix on page 124.]

Mr. GARAMENDI. Thank you very much, Mr. Ulmer.

Mr. Bromberg.

**STATEMENT OF MATTHEW F. BROMBERG, PRESIDENT,
MILITARY ENGINES, PRATT & WHITNEY**

Mr. BROMBERG. Good morning. Thank you, Chairman.

Chairman Garamendi, Chairman Norcross, Ranking Member Lamborn, Ranking Member Hartzler, and distinguished members of the House Armed Services Committee, thank you for the opportunity to appear before you today to share Pratt & Whitney's role in the production and sustainment of the F135, the propulsion system for the Joint Strike Fighter.

Also, thanks for the constant congressional support of this program. I also want to acknowledge Under Secretary Lord, General Fick, and Lockheed Martin for their partnership.

From the 369,000 Wasp engines produced in World War II to nearly 200 F135 engines we will deliver in 2020, every Pratt & Whitney engine bears a seal that proclaims two words: dependable engines.

Our focus today and tomorrow remains squarely in supporting the warfighter and doing so in a manner that safeguards the American taxpayer.

The F135 propulsion system is the world's most powerful and advanced operational fighter engine. The F135, developed with our international partners, provides unmatched performance, safety, reliability, and affordability, all of which contribute to the National Defense Strategy.

Production and affordability are top priorities. Today, we have produced more than 500 F135 engines and in 2019 we are on track to produce our contracted engines, doubling our output over the past 2 years.

In 2020, we aim to achieve a production rate of approximately 200 engines and modules per year, which will remain steady for the program of record. We are also investing in surge capacity to support increases in production and sustainment.

Through a jointly funded war on cost, Pratt & Whitney has reduced the average production cost of the F135 by 50 percent. While we are pleased with our progress to date, we recognize the imperative to do more.

Looking forward, we have the opportunity to invest in longer-term cost reduction projects such as developing alternative suppliers and leveraging advanced manufacturing technologies in digital, automation, and additive.

These activities require a long-term vision and consistent funding. With a worldwide fleet of more than 500 F135 engines, Pratt & Whitney is driving towards world-class sustainment.

As the fleet grows, we are committed to reduce sustainment costs by 50 percent. The most important factor is reliability and, fortunately, the F135 has consistently exceeded 94 percent mission capability.

Pratt & Whitney drives high mission capability through advanced digital analytics, prognostics, and health monitoring. In addition, the component improvement program is a critical funding priority to maintain levels of reliability and low-cost sustainment.

Effective sustainment requires collaboration between the government and Pratt & Whitney. We have a strong history of public-private partnerships and working across government agencies. Sustainment is a core competency.

We support more than 100,000 engines around the world between our commercial and military franchises and we are committed to sustaining the F135.

With development of the baseline Joint Strike Fighter program complete, focus is now on modernization. It is important to assure that the growth in aircraft capability is matched with propulsion growth.

Fortunately, the F135 has ample design margin to permit agile upgrades. We are, again, working closely with the Joint Program Office to develop a propulsion upgrade roadmap.

In conclusion, the F135 is an integral part of the National Defense Strategy. The F135's unique capabilities of power and stealth provide the warfighter vital advantages.

The F135 supports more than 33,000 high-technology jobs across 31 States. We remain laser focused on meeting our commitments, production, cost, readiness, life cycle affordability, and propulsion growth. We are committed to delivering the most capable engine to the warfighter while providing the most value to the taxpayer.

Thank you again for the opportunity to appear before the subcommittees. I, too, have a written record which will be submitted in. I look forward to your questions.

[The prepared statement of Mr. Bromberg can be found in the Appendix on page 142.]

Mr. GARAMENDI. I almost want to invite Ms. Maurer to join us at the table. So, if you would come up, we may ask some questions because we are going to go right back at issues we talked before. Prerogative of the chair to change things if the chair thinks it is important, and I do.

We had a lot of questions that were asked of the previous panel, all of which are questions that should be asked of the two of you and, Ms. Maurer, you may want to comment along the way or maybe ask to comment along the way.

Where to start? Lockheed Martin—Mr. Ulmer, you own ALIS. What are you going to do about it not working?

Mr. ULMER. Yes, sir. We have been working for some time now to improve the ALIS system.

Mr. GARAMENDI. Let us go right to the heart. Are we headed for a new architecture?

Mr. ULMER. Yes, sir.

Mr. GARAMENDI. And how long will it take and what will it be to bring that new architecture on, and will it be secure?

Mr. ULMER. Lockheed Martin is working with the Joint Program Office and our international partners relative to establishing, as you heard in the previous panel from General Fick, that we are targeting September of 2020 relative to implementation of that new architecture, and it will have the security requirements from cybersecurity as well as sovereign data management.

Mr. GARAMENDI. Your original contract called for ALIS to work. It doesn't. Are you paying for the upgrade?

Mr. ULMER. We are spending about \$50 million relative to internal funds to improve ALIS—as General Fick alluded to, classic ALIS. We are also implementing additional company funds in the order of \$120 million in terms of the new architecture investments to support the path forward.

Mr. GARAMENDI. I am going to turn the remaining 3 minutes 43 seconds over to Ms. Escobar.

Ms. ESCOBAR. Chairman, thank you so much.

Mr. GARAMENDI. Plus five if you need it.

Ms. ESCOBAR. Well, thank you so much, and good morning. Thank you all for your testimony and for your time here today.

Mr. Ulmer, I really appreciated that you laid out exactly how you have been able to ramp up and prepare and plan ahead, and I actually would like to know a little bit more about your plan going forward.

You know, the GAO report talked about some trade complications with regard to parts and would like to know about your long-term plan for the parts, and would you be using U.S. sourcing?

Do you have a 5-year timeline, 10-year time line sort of a vision? Does Lockheed have a vision for assisting us and, if so, if you wouldn't mind laying that out in a little bit more detail than in your testimony, please.

Mr. ULMER. Okay. A little clarification on the question. Are you talking about from, like, a Turkey alternate resource?

Ms. ESCOBAR. Yes.

Mr. ULMER. All from a Turkey alternate resource?

Ms. ESCOBAR. Yes, sir.

Mr. ULMER. Yes, ma'am. We are on a trajectory to resolve all the alternate resource parts by March of 2020. As General Fick alluded to in the previous testimony, there are a handful of parts on the order of magnitude of 20 that are beyond that March 2020 timeline.

But by December of 2020 we will have the ability as the—on the airframe side to completely resource all material from Turkey. There is approximately 850 parts. We understand each one of those parts in terms of what alternate resources requirements are doing.

We are approaching those within the United States capacity and ability—approaching the supply chain to manage those parts. We are also—in some cases in the international environment we have supply that is already being provided by current international participants that produce similar or same parts. We are taking advantage of that relative to risk reduction of those parts.

So, it is a full enterprise approach relative to managing those parts. But I want to assure you that by the end of next year all of those parts will be resourced and we are well on our way.

Many of the 850 so have already been resourced and are protected.

Ms. ESCOBAR. Thank you so much, sir.

Chairman, I yield back.

Mr. GARAMENDI. Thank you, Ms. Escobar. Thank you very much.

Mr. Lamborn.

Mr. LAMBORN. Thank you.

And I am going to follow up on some of these major issues that we have been talking about. But first I want to bring up an issue I don't think we have touched on yet and that is simulator servers, and my understanding is that we have had an unusually high failure rate among the simulator servers and that many locations have had to wait months to receive repaired servers.

So, Mr. Ulmer, given the severe impact that this has on training, what is Lockheed Martin doing to ensure that this will not be a problem in the future?

Mr. ULMER. So, we have had an infant mortality issue with the blade servers, and we have modified those servers. That modification occurred in May of 2019. We have seen significant improvement from that modification.

Today, we are currently going to each site to update those servers. We are doing it in a fashion such that as we remove a server for use, we rework that server and we have a return pool to try to rapidly backfill those parts back into the supply base.

So, our approach is really to get a supply pool that is being worked as we pull parts from the sites and then we position those parts back in as quickly as we can.

Mr. LAMBORN. So, I realize security concerns are paramount here, but you are producing enough spares that you can quickly do replacements when one breaks?

Mr. ULMER. Yes, sir. We have worked with Collins, a supplier, relative to that and we are buying additional spare capacity on top of the requirements just to sustain and maintain the units.

Mr. LAMBORN. Okay. Thank you.

And for both of you, when it comes to intellectual property, I am really concerned about the issues that we have had so far. You know, the taxpayer paid, ultimately, for the intellectual property.

So, what are your two companies' current positions on intellectual property within the F-35 program and will the government have access to all of the IP that it needs to sustain and operate the F-35?

Mr. ULMER. Chairman, I would offer that data rights and intellectual property, as we heard from the first panel, is a significant issue.

The beginning of the F-35, the approach for data rights was really focused on four tenets: to support operations; to support maintenance, align maintenance; to support the standup of the bases; and to support training.

As the programs matured and progressed, the U.S. Government position on data rights and IP has matured and progressed relative to that. So we have work to do as an enterprise relative to that data rights associated with the F-35.

I also would like to emphasize the supply base for the F-35. Lockheed Martin is responsible for approximately 30 to 40 percent of that intellectual property.

The other is third-party suppliers, and so Lockheed Martin is working with those third-party suppliers to establish data rights required to support the enterprise, going forward.

Mr. LAMBORN. Mr. Bromberg.

Mr. BROMBERG. Yes, sir. Thanks for the question.

First, for the F135 our development, production, and sustainment contracts have data right packages included in them and we are compliant with those.

Secondly, when design the engine and produce the engine, we design it with sustainment in mind, and when we plan to sustain the F135 we will do so initially at the Tinker Heavy Maintenance Center in Oklahoma City where we sustain many other U.S. service

engines. And there we provide all the tactical data for those maintainers to ensure they can deliver and support the F135.

We are incentivized to do that based on the mission capability metrics of the performance-based logistics contract. It is how we have done every other management program and how we will execute this one.

Mr. LAMBORN. Okay. Thank you.

Mr. Ulmer, I will finish up with this question. Given the challenges we've seen with the management of the F-35 supply chain, isn't it premature to jump into a 5-year contract—performance-based logistics contract—as opposed to going on a 1-year cycle where we make sure all the bugs are worked out before we go to a 5-year cycle?

Mr. ULMER. That is the discussion we are having with the OSD and JPO today relative to what is the appropriate approach to a performance-based logistics contract.

The benefit of stepping to a performance-based logistics contract today is today we do annualized contracts and within those annualized contracts the industry does not have a long time to make an investment relative to cost-saving initiatives to get costs out, to bring improvements forward relative to a new part on the aircraft.

We have examples where we have resourced parts on the airplane to take advantage of life-cycle cost savings, in particular the digital—the distributed aperture system where we have resourced a completely new component on the aircraft. It is forecasted to save \$3 billion across the life of the program.

It will be 45 percent more reliable. It has twice the capability of the current and that is the kind of investment we want to make over a longer-term horizon is that kind of opportunity to make those kinds of investments to bring the price down.

Mr. LAMBORN. Okay. Thank you.

And since you are here, Ms. Maurer, could you comment on this before I yield back?

Ms. MAURER. Sure, real quickly.

Mr. LAMBORN. The indulgence of the chairman.

Ms. MAURER. Yes, thank you for the question.

From a GAO perspective, we think that there are potential benefits of going to multiyear performance-based contracting approach for sustainment. That is a general proposition.

However, in a report that we issued last year we expressed some concerns about DOD's ability to enter into such multiyear contracts in part because the Department lacks good information about the overall cost of sustainment as well as the unresolved nature of many of the data rights and intellectual property issues.

We think that these issues need to be resolved before DOD can enter into long-term sustainment contracts—multiyear sustainment contracts.

Mr. LAMBORN. Okay. Thank you.

Mr. Chairman.

Mr. GARAMENDI. We are coming down to a smaller group here, so we are going to be a little less formal.

Mr. Lamborn raised an extraordinarily important issue. Ms. Maurer, you commented on that, and the Department and the negotiations are underway for a multiyear contract.

And I want you to go back to what you were saying and go into more detail about the issues that need to be resolved or at least a pathway to resolution before we move to a multiyear contract. If you will hone in on that.

Ms. MAURER. Sure, absolutely.

So in the report that we issued last year we talked specifically about the Department's lack of good information about what the true costs are for sustaining the F-35 and we think that is an important part of the Department's ability to negotiate with a contractor for that, get the best bargain, the best value for the money that the taxpayers will ultimately be responsible for these costs.

DOD, at the time of our report, did not have good visibility and understanding of the overall costs of sustainment. That is one issue.

Mr. GARAMENDI. This is an issue that has—that requires our attention. We are talking \$1.4 trillion over the next 25 years or so—an extraordinary amount of money that is really going to be controlled by two companies, both of whom are at this table.

Now, that is a pile of money. Obviously, you have subcontractors that are—and others that are involved in this including the military portion of the \$1.4 trillion or so.

This—our committees—Mr. Norcross and I are not going to back away from getting into the detail and for my part here I don't see a multiyear contract going forward until the fundamental questions that have been asked thus far and several that have not yet been put on the table are resolved.

And heretofore the contractors have had the long end of the lever and the government has been on the short end of the lever. That is going to change.

That is going to change because thus far this program has not worked well. Made progress, no doubt about it. But we got some very, very serious problems that have to be resolved.

And so, the power is shifting so that the government will have at least that fulcrum moving closer to the government side as we go into these years out ahead.

So be aware, gentlemen. Be aware. We have got to solve these problems and there is a whole list of them.

Mr. Norcross, it is your turn.

Mr. NORCROSS. Thank you.

Mr. Ulmer, just quickly, let me follow up. I don't want to talk too much. You said 30 to 40 percent of the intellectual rights are with Lockheed Martin, assuming the others are with whom? The gentleman to your left? Subcontractors that you control or subcontractors that others control?

Mr. ULMER. It is a mix. There is GFE—government-furnished equipment—on the aircraft. There is the additional subtiers under Lockheed Martin that control that, the different industry elements of the program.

Mr. NORCROSS. So you will have control over your subcontractors in this issue?

Mr. ULMER. Yes, sir.

Mr. NORCROSS. The ones that, obviously, we have? Okay. Just putting that aside. So, we heard a lot today about issues that have gone on and I think it is important to talk about those.

But I also want to say bringing down the cost per unit, it is a very good thing. But those costs, will we accelerate those even though we are bringing them down? We are shifting over to Mr. Garamendi's committee those sustainment costs and that is a big issue.

Turkey—the parts supply has always been a challenge for you—things that you control versus things that we control or, certainly, the engine compartment.

When we are setting up the 850 parts that Turkey was involved in, who was making the actual decision who is going to stand up with which companies, and for both of you I assume you make the decision for your engine components and who—how do you make that decision versus oversight from others? We put you in that position by pulling Turkey out.

Mr. ULMER. So, we follow our normal resource acquisition process, which we do each and every day. So, we are constantly looking at do we have the appropriate supply base, do we need to seek alternate sources for other reasons than political.

It might be financial performance. It might be poor health of a company. It might be poor performing equipment. We have a very detailed process relative to how we resource our material or source our material.

Mr. NORCROSS. But for Turkey you are following—

Mr. ULMER. We are following our normal process in conjunction with sharing that information with the Joint Program Office.

Mr. NORCROSS. Okay. So, when we start dealing with that were you anticipating that the parts that you are getting today from Turkey were going to continue to this point? Were you surprised in your planning for moving forward?

Mr. ULMER. I don't quite understand the question. Were we—

Mr. NORCROSS. The initial question when Turkey was going to be informed that they were suspended from the program there was a potential for the parts to stop that day.

Mr. ULMER. Yes.

Mr. NORCROSS. Which would have put us in a very precarious situation and throw our schedule way off. They are still supplying and is there reason to believe that they might stop anytime soon?

Mr. ULMER. Other than politically, no. The Turkish industry is very much a part of F-35. They are strong performers. They produce high quality at a low cost.

They are very interested in if in a political environment able to remain within the F-35 program they desire to do so. Other than politically, we are not concerned relative to that supply.

Mr. NORCROSS. So, they could continue, hypothetically, to supply us. Up to what point are you planning now to cut them off and be cut off by—

Mr. ULMER. Per direction, we have been directed to target March—end of March 2020—to terminate our relationship relative to Turkish supply.

Mr. NORCROSS. And that—

Mr. ULMER. Our approach—our approach to date—

Mr. NORCROSS. Transition does not postpone any of the production line by that standard?

Mr. ULMER. No, sir. Our approach to date was we are not opening any new additional purchase orders or ordering additional material beyond the March of 2020 timeframe.

If Turkey has the capacity and ability to produce additional parts within that time slot between now and March in 2020, industry will take advantage of getting that supply.

Mr. NORCROSS. That was a best-case scenario when we were talking about this over a year ago.

Mr. ULMER. Yes, sir.

Mr. NORCROSS. So, when the sole source contracts for those 850 parts—is it a competitive contract with you or does that have more to do with who can get that to us quicker?

Mr. ULMER. Chairman, first off, it is not just single source. We have actual single source, dual source, and even triple source.

Mr. NORCROSS. Right. I am just talking about the single source replacement for Turkey parts.

Mr. ULMER. Yes. Restate the question, please.

Mr. NORCROSS. Is it—when you go for the single source, which I think there is only maybe a half dozen critical items in there, is that a competitive contract to you or is it who can supply that part in the timeframe we need?

Mr. ULMER. In this specific—in this specific circumstance if there is competition to be had, we will approach that from a competitive situation. If there is a—if there is an industry participant that has that capability, a subject matter expertise that gets to a quick solution, we will procure it immediately that way to protect the risk—against the risk—and then over time we will competitively bid that work beyond this period of performance.

Mr. NORCROSS. So short term it is a risk. Long term it is pricing.

Mr. ULMER. Yes, sir.

Mr. BROMBERG. And, Chairman, I would like to just add from a Pratt & Whitney perspective, we have 200 parts that have been sourced in Turkey. The Turkish suppliers are actually high-performing suppliers, as you have heard today. Low cost, high quality, on-time delivery.

We have been coordinating our actions with the Joint Program Office for actually the past couple years and, like Lockheed Martin, we are on track to handle a separation in March of 2020 with potential a final separation in December of 2020.

To your question of how we resourced it, we actually sourced about 80 percent of those parts back into the United States for the sake of speed in order to protect the program schedule and many of the most critical parts are actually back into Pratt & Whitney where we have the capability to ramp up much faster than working anywhere else.

So, we did that for the sole reason and in conjunction with the Joint Program Office to protect the speed of the production line.

Mr. NORCROSS. Just real quickly, are all the new suppliers U.S. based or do any of our partners get a taste?

Mr. ULMER. Initially, we—from a Lockheed Martin perspective, we sought U.S. sources. There were some specific cases where in-

ternational partners already were sourcing the same exact material. So to reduce risk we went with those international companies.

Mr. BROMBERG. Exactly the same position for Pratt & Whitney. About 80 percent were sourced in the United States where we had existing capacity or the capability to do the work; 20 percent went to international suppliers that already did similar work and can ramp up quickly.

Mr. GARAMENDI. Mrs. Hartzler.

Mrs. HARTZLER. Thank you, Mr. Chairman.

Let us talk about parts a little bit here. Reliability and maintainability is really important—that the part is reliable, it does what it is supposed to do, and we are able to maintain it, and I understand that we have been making steady progress on both of those fronts.

So how has the reliability and maintainability improvement projects—how are they progressing and to what extent are these projects having any impact, positive or negative, on the manufacturing floors?

Mr. Ulmer.

Mr. ULMER. Yes, ma'am.

If we look over the course of the procurement of the aircraft in particular from Lot 6 annually to today, reliability and maintainability has improved significantly lot over lot.

So, the aircraft today that we are delivering today are a lot more reliable than the ones we delivered 6 years ago, 7 years ago.

We continue to focus on reliability and maintainability improvement on the program. I will tell you, in comparison to other programs the enterprise has not necessarily funded reliability and maintainability improvements.

To give you an example, on the F-22 program, which has a fleet of approximately 185 aircraft, that program funds approximately \$70 million in support of reliability and maintainability improvements on that fleet.

This year in this FY [fiscal year] the F-35 program has funded \$7 million for a fleet of 455 aircraft. That said, industry has made a significant investment relative to reliability and maintainability improvements on the platform and that really is the reason why lot over lot we have seen that significant improvement as those parts become more reliable in the fleet.

Mrs. HARTZLER. Great. Thank you.

Mr. Bromberg.

Mr. BROMBERG. Yes, ma'am. So, from an engine perspective, the F135 is the most reliable fighter engine we have ever produced. In 230,000 hours of operation it has maintained an average mission capability of north of 94 percent and, in fact, this milestone in service, 200,000 hours, it is 10 times more reliable than the F-100 was at the same milestone.

So, I think that is a testament to the fantastic engineers and technicians in Pratt & Whitney that know how to design dependable engines.

However, we have to be vigilant, and just as Mr. Ulmer said, we are firmly supporting the component improvement program which has a proven track record on all our engines at addressing reliabil-

ity issues early when it can be done cost effectively and ensure sustainment and mission capability.

Mrs. HARTZLER. Great.

Let us talk about availability because that has been an issue—the availability of parts and flight lines are just down, waiting, and even our forces are having to cannibalize some of the parts from other aircraft to keep them flying.

So, what are you doing to work with DOD and the Joint Program Office to improve the management of ready-to-issue spare parts, and I would also say not just the management but the availability of the parts?

Mr. ULMER. Several different aspects in terms of our approach to improve reliability of parts on the aircraft and availability of parts on the aircraft.

First, in the lots—again, back to Lot 16 we went to what was called a Tech Refresh 2 configuration for the F-35. We had—we have some units that we needed to accelerate those updates to those airframes to get more reliable parts. An example is Eglin Air Force Base had a fleet of aircraft that did not have that refresh in them.

And so, as part of the acceleration process we went and accelerated the implementation of that Tech Refresh into those fleets such that they have newer, more reliable parts.

We also have a reliability improvement program where you identify the top poor performers on the aircraft in terms of those items need to be improved.

And so, we understand what those are and we have historically worked those top performers down. We are also improving the health diagnostic system on the aircraft. Many times, from an availability perspective, we were telling the mechanic or the technician—the flight line technician—to remove a part when in fact it was not broken.

And so, the health diagnostic system on the airplane, when we went from the development program to the 3F configuration we saw a 60 percent improvement of no false alarms of those parts on the aircraft.

So we are no longer having the mechanic take that part off the airplane and staying on the airplane.

Mrs. HARTZLER. So, the question was more—not so much issues with parts that are already on but the availability, that they are available to begin with.

So, what are the parts that you seem to have a shortage of the most? Is the canopy an issue? What are some of the other parts that you are short?

Mr. ULMER. So, the primary driver as alluded to by General Fick is the canopy. The wing-tip lens is another part from a portability perspective. We understand each one—each and every one of those parts.

Ready for issueness has also been—the issue has been with the electronic digital file that is associated with those parts. The GAO report indicates that as an issue on the platform.

In the last 2 years, we have done several things to resolve that problem. One is any parts coming out of the facility when we de-

liver an aircraft, we ensure that those electronic files are correct and appropriate.

For the parts coming out of the warehouse, we are ensuring that those parts from a digital pedigree are appropriate and can be consumed by the warfighter without issue.

There are parts within the supply that still have that issue that were issued prior to our corrective actions. Within the last 2 years we have cleansed that data by approximately 50 percent, and so we have taken an extreme effort relative to cleansing the data associated with those parts such that when the mechanic goes to reach that item off the shelf and implement it, it is in fact capable of doing so.

Mrs. HARTZLER. Great. Can I—

Mr. BROMBERG. Do you mind if I also answer the question, ma'am?

Mrs. HARTZLER. No way. No. Sure.

[Laughter.]

Mr. BROMBERG. You know, I think—from an engine perspective again, we contract separately from the airframe. We plan our production systems separately from the airframe and we are going to maintain sustainment separately from the airframe.

We collaborate in many areas but there are some differences. In terms of how we think about the demand for production and sustainment, from the inception we design our engines for sustainment, as I mentioned before.

So, when we loaded the capacity requirements to produce parts, we loaded all those for new engines, modules, and spare parts.

As a result, we actually have a fairly significant stock of spare parts both in Pratt & Whitney and military facilities around the world, and part of our mission capability is because our nonmission capability due to supply when the part is not available is averaging less than 2 percent.

Mrs. HARTZLER. That is great.

Mr. BROMBERG. So, I think the team has done a nice job. We need to remain vigilant because, as we have talked about in the prior panel, that forecasting and stocking problem changes over time. But we have got dedicated sustainment professionals and that is what they do.

Mrs. HARTZLER. Great.

Mr. Chair, can I ask one more question here?

Mr. GARAMENDI. Do you need more time?

Mrs. HARTZLER. I do need more time.

Mr. GARAMENDI. Go for it.

Mrs. HARTZLER. Okay. So, Mr. Ulmer, a recent Department of Defense inspection general report titled "Audit of F-35 Ready-for-Issue Spare Parts and Sustainment Performance Incentive Fees" found that the DOD did not receive ready-for-issue F-35 spare parts in accordance with contract requirements and paid performance incentive fees on the sustainment contracts based on inflated and unverified F-35A aircraft availability hours. So, do you plan to reimburse DOD for these pay performance incentive fees?

Mr. ULMER. Ma'am, the current recent sustainment contracts have those incentives now embedded in them relative to our performance. So previously, prior to that report, we did not have that

kind of incentive. We do now in terms of issue effectiveness, part availability, those kinds of metrics.

Separately from that, on our own accord we are off cleansing the data, as I just—as I just testified—relative to resolving that problem at our expense to cleanse those parts.

Mrs. HARTZLER. So, going forward, this isn't going to be an issue and just to clarify, going back, what this audit was on you say you have paid back those fees?

Mr. ULMER. No, ma'am. We haven't paid back those fees. Prior to this—prior to the implementation of those incentive fees, we did not have that in terms of the contract performance. We do today. So, I don't earn a fee today if I have those issues.

Mrs. HARTZLER. Okay. All right.

I yield back.

Ms. MAURER. Mr. Chairman, could I—30 seconds on reliability and—

Mr. GARAMENDI. Yes, please do.

Ms. MAURER [continuing]. It is directly relevant to the ranking member's question.

A good thing for further oversight is to recognize the fact that the operational requirements document that underlies the F-35 has eight reliability and maintainability requirements; four of those eight are being met.

Those are the four that are contractually required. The other four that are not contractually required are not being met, and that is an issue we have reported on extensively over the last couple of years.

Mr. GARAMENDI. So, it helps to have a contract?

Ms. MAURER. Absolutely, and put it into the contract. Yes.

Mr. GARAMENDI. Well, I have got so many questions, but I am going to turn to Mr. Brown and try to control myself.

So, Mr. Brown.

Mr. BROWN. Thank you, Mr. Chairman.

Once again, I want to thank both chairs and both ranking members for conducting today's hearing as we conduct our responsibility—our congressional responsibility or oversight responsibility of the F-35 program sustainment, production, and affordabilities.

And I am especially pleased that for today's hearing and this panel here because this is the first time in my 3 years as a member of the House Armed Services Committee that I can recall that we have invited our defense industrial base partners to present and make themselves available to questioning from Members of Congress and I think that it is important.

I do also want to once again thank Ms. Maurer, you and your colleagues at the Government Accountability Office. I can tell you that I frame my positions—I base many of the decisions that I make as a member of this committee based on the good work that you do. You are our watchdogs and you do fantastic work.

I had an opportunity to visit on July 30th the F-35 production line. I hope perhaps to get out to the F135 production line at Pratt & Whitney in the near future and I want to certainly take the opportunity to thank Lockheed Martin but more particularly the members of the team—the members on that production line who I had an opportunity to meet with—the machinists, the assemblers,

the mechanics, the coders, and from the engineers to the back office that is a group of dedicated men and women who are doing their very best to make sure that our warfighters have the systems, the platforms, that they need to do their job, to do effectively, and to come home safely to their families.

So, to Lockheed Martin and to—I am sure the same can be said about the men and women at Pratt & Whitney. I thank that dedicated workforce.

Ms. Maurer, maybe we can do another sort of back and forth, this time with you and Mr. Ulmer. You had, in the GAO report, sort of four categories where you grouped your recommendations.

One was DOD lacks critical information to effectively plan for long-term F-35 sustainment and one of the recommendations there was that the DOD needs to obtain comprehensive cost information for F-35 spare parts.

Can you just sort of, you know, flesh that out a little bit? What was the problem? What is the recommendation and then perhaps Mr. Ulmer can be responsive to your remarks.

Ms. MAURER. Sure. Absolutely.

So, I think as we all know, when the program was first launched it was launched under a very different construct than programs are typically launched today.

Back when it was started almost 20 years ago, the idea was that the government was going to hand over logistics support almost entirely to the contractor. So that is the way the program was formulated and executed for a number of years.

Fast forward to now, when the Defense Department is trying to get a clean financial opinion, one of the big challenges it is facing right now to get that clean financial opinion is putting a dollar value on the parts that it is purchasing for the F-35 program.

One of the things we found in our report earlier this year is that DOD currently literally doesn't know where the parts are and they can't match up the dollars that they spent back to specific major end items and major parts.

That makes it very difficult for them to get a clean financial opinion. I know that right now the Joint Program Office and OSD is working closely with Lockheed and the other contractors to resolve that issue.

But since that wasn't built into the contract, it wasn't built into the structure of the program, it is a pretty major undertaking.

Mr. BROWN. So, Mr. Ulmer, what is industry doing to assist the Department in addressing that recommendation?

Mr. ULMER. First off, I would like to say I believe we have a very solid working relationship with GAO. We do an annual review on the program—a deep dive on the program—and then we support any specific audit or request with full transparency with the GAO.

Relative to the parts, Lockheed Martin has a property management system that is accredited by DCMA, the Defense Contract Management Agency. We are working right now with the JPO relative to the program office setting up their own property management system.

We are supporting that effort as we speak across the entire F-35 enterprise. So, we will help and we are helping the JPO program office acquire all that information as alluded to.

Mr. BROWN. Ms. Maurer, are you—do you have anything that you want to add or—

Ms. MAURER. We are aware that this is an ongoing initiative. It is something that is going to take a while to dig out from. It is not something that is going to resolve very quickly.

We are encouraged by the progress we have seen from the JPO and we want to see them work closely with Lockheed as well.

Mr. BROWN. Thank you.

Mr. Bromberg, let me ask you, what is Pratt & Whitney doing to help the government reduce its procurement costs for engines and subsequent sustainment costs after fielding?

Mr. BROMBERG. Yes, sir. Thanks for the question.

As I indicate in my remarks, we are pleased with the 50 percent reduction of the unit price of an F135 to date but we are not satisfied that that is enough, going forward.

We recognize that the strategy we used to achieve the 50 percent reduction needs to evolve. The program I alluded to was a jointly funded government-Pratt & Whitney program called Pratt's War on Cost—\$200 million of investment that yielded 2,000 different actions that took 50 percent of a unit price of an F135 down, resulting in \$7 billion, \$8 billion of program savings to the government. Very successful program.

However, where we are now with 500 engines in service, a very stable engine configuration in achieving that 94 percent mission capability that we talked about, we need to shift to a different strategy that allows us to leverage the long-term procurement plan for the F135 and maintain a stable configuration for the engine so we can maintain the reliability.

So the way we will do that is by leveraging two primary areas: one, advances in manufacturing technologies that did not exist when we launched the program such as digital, automation, and additive; and secondly, developing alternative suppliers where we find we don't have enough of a competitive landscape so that we can get true value to the taxpayer. Those are both long-term strategies but strategies that we are working with the Joint Program Office to embrace.

That cost reduction I talked about will lend directly to sustainment cost reduction. In terms of a depot visit, 60 percent of the cost is from new materials. So the more we reduce the price of an engine and the materials that go into it, the more cost effective the maintenance is.

Secondly, it goes to the component improvement program, sir, we talked about earlier, make sure you maintain reliability. And, finally, it's effective management at the operational level and the depot level, something Pratt & Whitney takes very near and dear to its heart.

We have thousands of sustainment professionals and we are going to work collaboratively with the government to do that.

Mr. BROWN. Mr. Chairman, if I could have the benefit of the same indulgence that you showed to my colleagues. I just have one more question.

Mr. GARAMENDI. You are stretching it.

Mr. BROWN. Short question. Hopefully a short answer.

Just for Mr. Ulmer, how confident are you that you will get to \$25,000 cost per flight hour by 2025 as you have stated and what tools do you need from the Department or Congress to help you get there?

Mr. ULMER. The confidence is high if we resource load the approach, and what does that mean? The resource load of the approach is General Fick and Ms. Lord indicated we have a life cycle sustainment plan. We need to make sure that we apply the necessary resources to that plan to allow the cost savings on the back side of that plan.

And then the other element I would add is the performance-based logistics contract. We need a long-term contract relative to allowing industry to make those investments over a longer period of time that have those cost savings reductions on the back side.

We have a history and Blueprint for Affordability [BFA] on the F-35 program. Two different cycles. The BFA 1 cycle with a \$500 million investment; over the life cycle of the program, a \$6 billion savings across that life cycle. That is the approach and the benefit relative to that.

Mr. BROWN. I thank the chair and I yield back no time.

[Laughter.]

Mr. GARAMENDI. Always sufficient time for good questions and thank you for the good questions.

We are really out of time. The next hearing is about to—will commence in less than an hour and they are going to bring the doggies in here to make sure that none of you are leaving some of your equipment behind to snoop on what the next classified hearing will have.

Going forward, heads up. If you haven't figured it out, the Readiness Subcommittee, together with the Tactical Air and Land will be coordinating our efforts in the months ahead to drive out of this F-35 program the known problems.

There is a long list of them. GAO—Ms. Maurer, you and your team are extraordinarily important to us, to this program, and to the contractors for their attention to issues that they may not observe or be willing to observe, and so we are going to really rely heavily on you.

Also, I want to point out that the professional staff here, Ms. Harris from my staff and the professional staff on Mr. Lamborn's side, Mr. Norcross, have done an extraordinary job following this along.

We are going to come back at this in January and we are going to go at it in additional detail. We didn't get into the cataloguing issue, into the issue of parts which, fortunately, Mr. Brown has brought up together with Mrs. Hartzler. We are going to go at those in more detail.

There is a transition underway here from total reliance upon the contractors to a shared responsibility into the future.

It seems to me, and I will put this on the table because I am sure it is going to happen, is that the services, now that they are getting these planes and being held accountable for the operational readiness of the planes, are going to demand more authority and responsibility, and that is going to shift the nature of the Joint Program Office in the future and shift the relationship between the contrac-

tors and the Department of Defense, Joint Program Office, and the various services. That shift is already underway. The Defense Logistics Agency is going to be playing a major role, going forward.

Thank you, Ms. Maurer, for pointing out that there are 7,000 parts that the Defense Logistics Agency has on various shelves somewhere around the world. Sixty-three hundred of those are parts that fit various tranches of the F-35.

So how does that fit into this? What are the roles of these various agencies, going forward? We are looking at—I was reminded that I will not be here for the end of this program, which is apparently not 20 years from now, which was my personal time horizon, but 58 years from now. Not likely to be my responsibility then.

However, for us, this is our here and now. We got to get this right, and so we are going to rely on everybody, going forward.

I want to particularly thank my colleagues here for their questions, for their attention to this matter.

We will see you in mid-January. Thank you so very much.

This hearing is adjourned.

[Whereupon, at 12:41 p.m., the subcommittees were adjourned.]

A P P E N D I X

NOVEMBER 13, 2019

PREPARED STATEMENTS SUBMITTED FOR THE RECORD

NOVEMBER 13, 2019

Statement of the Honorable John Garamendi
Chairman, Readiness Subcommittee
“F-35 Program Update:
Sustainment, Production, and Affordability Challenges”
November 13, 2019

Good morning. I'd like to welcome everyone to this joint hearing of the Readiness and Tactical Air and Land Forces subcommittees on the F-35 program.

The hearing comes at a critical time for the F-35 program. After nearly two decades of development, the aircraft has entered its operational testing period, is actively deployed around the globe, and has seen its first combat missions. Acquisition continues apace, and we've delivered over 450 F-35s to Air Force, Navy, Marine Corps, and key international partners. By 2023, the fleet is expected to include more than 1,100 aircraft stationed at 43 operational sites.

As DoD's costliest weapon system, it goes without saying that the F-35 has been the subject of much criticism. With acquisition costs expected to exceed \$406 billion and sustainment costs estimated at more than \$1 trillion over its 60-year lifecycle, this scrutiny is warranted. In fact, sustainment activities will ultimately contribute to 70% of the program's total costs. So today's discussion, the first F-35 hearing led by the Readiness subcommittee, will rightfully focus on sustainment issues.

The F-35 sustainment enterprise faces formidable challenges. These include unacceptably high operating and support costs, inadequate repair capacity at the depots, spare parts shortages compounded by insufficient reliability of parts and components, and deficiencies in the platform's Autonomic Logistics Information System, or "ALIS." As a result of these problems, only about half of the F-35 fleet was available to fly at any given time in 2017 and 2018. The program has also had a complex relationship with its prime contractors, Lockheed Martin and Pratt & Whitney, who bear responsibility for some of this program's sustainment challenges and from whom we will hear on a second panel.

While the Department paid insufficient attention to sustainment in this program's early years, we have seen an increased focus on these problems resulting in measurable progress that we should acknowledge. Costs per flying hour are decreasing, and the aircraft's mission capability rates – while still too low – increased this year, partially as a result of the spotlight placed on improving mission capability by former Secretary Mattis.

Yet attention to these problems must outlast any particular leader or directive. As we look ahead to the next few decades of F-35 service, failing to create an effective and cost-efficient sustainment system would diminish readiness, squander taxpayer resources, and discourage the services and our partners from continuing to purchase the F-35. This would create unacceptable risk for the

program and would be an abdication of the trust and investment of the public and our allies.

The capabilities the F-35 brings to the battlefield are essential to the objectives of our new national defense strategy and to those of our international partners. I am not interested in dwelling on the mistakes of the past, but I do think we all agree that the stakes are too high for us to allow this program to fail. We must take a constructive and collaborative approach toward solving the F-35's sustainment challenges, and I look forward to discussing how we can do so today.

With that, I would like to turn to our Ranking Member, Congressman Doug Lamborn of Colorado, for any remarks he may have.

Statement of the Honorable Doug Lamborn
Ranking Member, Subcommittee on Readiness
“F-35 Program Update: Sustainment, Production, and Affordability
Challenges”
November 13, 2019

Thank you Chairman Garamendi, I truly appreciate the opportunity to conduct this joint hearing with our colleagues on the Tactical Air and Land Forces Subcommittee. The F-35 program is an example of a program that seems like it was designed to be “too big to fail.”

From the program’s inception, the Pentagon struggled to resolve conflicts between the Services regarding the Joint Strike Fighter’s requirements, failed to protect the government’s ownership of intellectual property that was funded by taxpayer dollars, and failed to manage cost growth.

Lockheed Martin has delivered over 458 aircraft to our military and to international partners participating in the program. We now enter the period where sustainment and readiness of the F-35 fleet are critical to our national security.

One of the biggest concerns I have is whether the government has full access to the intellectual property required to sustain the F-35. I look forward to hearing from our witnesses in both panels about how we are addressing that issue. We are at risk of allowing one company to be in a monopolistic position to the government, which would enable it to charge a premium for sustainment contracts.

My next concern is that we must build capacity within the depots and maintenance systems of our armed forces. Failing to do so will guarantee future sustainment challenges. When you talk with pilots and maintainers in the field, they have serious concerns about the Autonomic Logistics Information System, known as ALIS, that supports mission planning, supply chain management, and maintenance. Operators are spending countless hours inputting data that is supposed to be automated. From my perspective it appears the software architecture is dated, and I look forward to discussing the way ahead.

Within the data management part of the program, I am also deeply concerned about simulator support for the force. My understanding is that there are significant issues in replacing the servers that support these systems, which significantly reduces the ability of our pilots to train.

Finally, supply chain management for F-35 is still a work in progress and has a long way to go. The prime contractor is responsible for managing replacement parts packages, and government personnel on site have limited to no visibility into the actual parts on hand. We are receiving consistent feedback from the field that these packages are not configured for the correct version of the aircraft they were provided to support. Because the contractor is managing the supply chain instead of the military, the program is incurring unnecessary costs to move parts between countries and support all partner nations.

I thank our witnesses for their testimony today. You are working diligently to address the shortcomings I mentioned. The foundation of these problems was laid decades ago in some cases, but we have to pick up the pace on sustainment as we get closer to full rate production. At \$406 billion for acquisition and more than \$1 trillion estimated for sustainment, we cannot afford further mismanagement of this program.

I yield back.

**Statement of the Honorable Donald Norcross
Chairman, Subcommittee on Tactical Air and Land Forces
“F-35 Program Update: Sustainment, Production, and Affordability
Challenges”
November 13, 2019**

I want to thank my good friends from California, Colorado, and Missouri for agreeing to this important joint hearing with the Members of the Readiness and Tactical Air & Land Forces subcommittees.

I too welcome and thank our distinguished panels of witnesses for taking the time to come before us to discuss this vital program.

To meet our constitutional oversight responsibilities, we must hear from the Department’s program leaders; as well as those independent agencies that help us with evaluating program progress or shortfalls. We should also take this opportunity to get onto the record the testimony of the two prime contractors responsible for the production and sustainment of this critical capability for the warfighter that the American taxpayer is funding.

I agree with everything already said here and note that the F-35 program is trying to recover from the risky acquisition decisions made by past program leaders; previous decisions that resulted in unforeseen increases in funding for development and production to address the failed assumptions made for the high concurrency designed into this program.

That bill, for past “acceptable” concurrency risk, is now due and has resulted in significant fiscal challenges facing us today.

Block “3 F” configured aircraft being delivered today are only somewhat combat mission capable. There are still material deficiencies that negatively impact the low-observability characteristics of this aircraft—and that only a 5th Generation aircraft provides.

And yet, while the System Development and Design phase of the program has officially ended, we now embark on the next upgrade known as Block 4 which is estimated to cost an additional \$20 billion in development and retrofit costs both for today’s fielded aircraft and future production aircraft to achieve full combat capability.

Today, we want to understand:

- What fixes are you making to the struggling Autonomic Logistics Information System, or ALIS;
- Where are we in finding and qualifying alternate sources of supply resulting from Turkey’s suspension from the program;
- What is the strategy and execution plan to establish greater capacity, effectiveness, and insight with the prime contractor’s deficiencies with supply chain and parts management currently plaguing the efficiency of the production line and sustaining fielded aircraft?

Finally, we'd like to learn what the Department is doing to establish common cost categories and metrics for evaluating the true ownership cost of aircraft, whether defined in terms of cost-per-flight hour or cost-per-tail-per year.

I believe it is imperative for leaders to establish Department-wide policy and guidance so that we're comparing costs with apples-to-apples input between and among legacy and future generation aircraft.

The Tactical Air and Land Forces subcommittee has and will continue to support the program, but we don't have unlimited resources which seem continually needed to achieve the elusive term associated with this program, "affordability."

With that, I again look forward to this hearing and yield back to my fellow Chairman.

Statement of the Honorable Vicky Hartzler
Ranking Member, Subcommittee on Tactical Air and Land Forces
“F-35 Program Update: Sustainment, Production, and Affordability
Challenges”
November 13, 2019

As the Chairman mentioned this hearing continues the committee’s ongoing oversight and continuing review of the F-35 program.

As Members of this committee we understand and recognize the importance of 5th generation capability as well as the need to grow additional 5th generation capacity in order to meet the objectives of the national defense strategy and maintain a credible deterrence posture.

I was pleased to see the latest F-35 production contract award, the largest in the history of the Department of Defense, has resulted in significant lower unit recurring flyaway costs for the F-35, from \$89.3 million per F-35A aircraft in the previous contract to \$77.9 million for this contract award representing a 12.8 percent decrease. According to the Joint Program Office, this \$34 billion agreement will see the delivery of 478 F-35 aircraft, which will almost double the size of the current F-35 fleet by 2022.

However, given the size, scope, and complexity of the program and that the fleet size will nearly double over the next two years, this hearing provides a timely opportunity to update our Members on the challenges currently facing the program going forward to include what actions are being taken now to ensure long term affordability and drive down sustainment costs.

I want to briefly run through a few issues that I expect the witnesses to cover today.

Regarding Turkey’s recent suspension and ultimate removal from the program I’m interested in receiving an update on the current posture of the F-35 industrial base, to include qualifying and ramping up alternative sources for the parts that were being produced by Turkey.

I expect the witnesses to update us on the acquisition plan, cost estimates, and test strategy for the Block 4 modernization program. I understand next year’s budget request will be the first production year for Block 4 aircraft and I’d like to know whether you are experiencing any challenges with the overall Block 4 development schedule and will these new aircraft result in higher unit costs.

We were recently notified that the full rate production decision has been delayed by over a year and I’m interested in hearing what programmatic impacts this delay would have, if any, on the program’s current acquisition strategy.

Today’s hearing is also a good opportunity to update us on some of the outcomes from the initial operational test and evaluation that is ongoing, specifically the challenges associated with developing the Joint Simulated Environment capability which is needed to realistically test 5th generation

capability.

And finally, I would appreciate the witnesses to the degree that they can in an open hearing address how they are approaching cyber security concerns and testing, specifically as it relates to the Autonomic Logistics Information System and the overall integrity of the supply chain.

I want to thank all of our witnesses for being with us today and look forward to an open and candid discussion.

Thank you Mr. Chairman and I yield back.



United States Government Accountability Office

Testimony

Before the Subcommittees on
Readiness and Tactical Air and Land
Forces, Committee on Armed Services,
House of Representatives

For Release on Delivery
Expected at 10:00 a.m. ET
Wednesday, November 13, 2019

F-35 AIRCRAFT SUSTAINMENT

DOD Faces Challenges in Sustaining a Growing Fleet

Statement of Diana Maurer, Director,
Defense Capabilities and Management

GAO Highlights

Highlights of GAO-20-234T, a testimony before the 16th anniversary on Readiness and Tactical Air and Land Forces Committee on Armed Services, House of Representatives

Why GAO Did This Study

DOD's F-35 Lightning II fighter aircraft provides key aviation capabilities to support the U.S. National Defense Strategy. The F-35 is also DOD's most costly weapon system, with U.S. sustainment costs estimated at more than \$1 billion over its life cycle. As of October 2019, there were more than 435 U.S. and international F-35 aircraft in operation, and more than 3,300 aircraft expected to be fielded throughout the life of the program. While there is little doubt that the F-35 brings unique capabilities to the U.S. military, DOD faces significant challenges in sustaining a growing fleet.

This statement discusses F-35 sustainment challenges. It also summarizes GAO's open recommendations related to these challenges.

This statement is based on previously published work since 2014 related to F-35 acquisition, sustainment, affordability, ALIS, operations, and the global supply chain.

What GAO Recommends

GAO has 21 recommendations related to the challenges described in this statement that DOD has not fully implemented. DOD generally concurred with all 21 recommendations. Continued attention to these recommendations is needed by DOD to successfully operate and sustain the F-35 fleet over the long term within budgetary realities.

View GAO-20-234T. For more information, contact Shere Beaman at (202) 512-9527 or shereb@gao.gov.

November 13, 2019

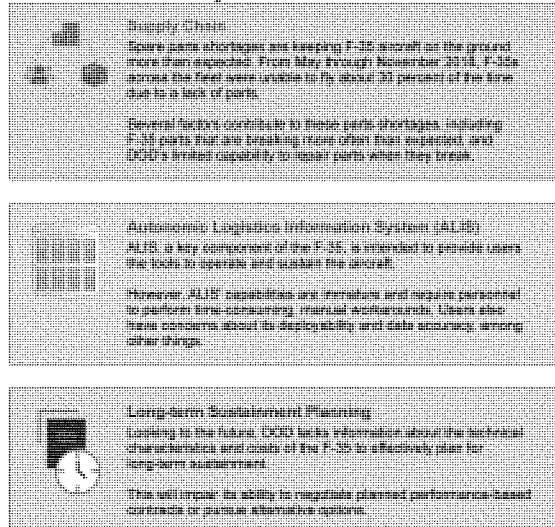
F-35 AIRCRAFT SUSTAINMENT

DOD Faces Challenges in Sustaining a Growing Fleet

What GAO Found

The Department of Defense (DOD) faces challenges in sustaining a growing F-35 fleet. This statement highlights three challenges DOD has encountered related to F-35 sustainment, based on prior GAO work (see figure).

Selected F-35 Sustainment Challenges



Source: GAO. | GAO-20-234T

As a result of these challenges, F-35 performance has not met warfighter requirements. While DOD works to address these issues, it must also grapple with affordability. DOD has determined that it will need to significantly reduce F-35 sustainment costs—by 43 percent per aircraft, per year in the case of the Air Force—in order for the military services to operate the F-35 as planned.

Continued attention to GAO's recommendations in these areas will be important as DOD takes actions to improve F-35 sustainment and aircraft performance for the warfighter.

Chairmen Garamendi and Norcross, Ranking Members Lamborn and Hartzler, and Members of the Subcommittees:

Thank you for the opportunity to be here today to discuss the Department of Defense's (DOD) sustainment of F-35 aircraft. As you know, the F-35 Lightning II provides key aviation capabilities to support the National Defense Strategy. It is DOD's most costly weapon system, with sustainment costs for the United States alone estimated at more than \$1 trillion. The F-35 is also DOD's most ambitious weapon system, with three military services and many foreign nations purchasing the F-35 for their militaries. While production continues to ramp up, as of October 2019, there were more than 435 U.S. and international F-35 aircraft in operation at 19 sites, with more than 3,300 aircraft expected to be fielded through the life cycle of the program.

We have published a series of reports examining both DOD's acquisition and its sustainment of the F-35. My statement today will focus on sustainment. Sustainment involves the activities necessary to operate aircraft after they are fielded—such as maintenance, supply chain management, training, and engineering support. Sustainment costs typically comprise about 70 percent of a weapon system's life-cycle cost. In particular, we have reported on significant challenges that DOD faces in sustaining a growing F-35 fleet. As a result of these challenges, F-35 performance has not met warfighter requirements. Mission capability—that is, the percentage of total time when the aircraft can fly and perform at least one mission—was 52 percent from May through November 2018, as compared with a warfighter minimum requirement of 75 percent. Further, although the United States is purchasing the F-35 for its advanced capabilities, during that same time period, full mission capability—or the percentage of time when the aircraft can perform all tasked missions—was about 27 percent, as compared with a warfighter minimum requirement of 60 percent.

Today I will highlight three F-35 sustainment challenges DOD has encountered related to: (1) the supply chain; (2) the Autonomic Logistics Information System (ALIS), which supports supply-chain management, maintenance, and other processes; and (3) long-term planning. I will also summarize our recommendations related to these issues that DOD has not fully implemented.

This statement is based on our body of work issued from 2014 through 2019 addressing F-35 acquisition, sustainment, affordability, ALIS, operations, and global supply chain. To perform our prior work, we

analyzed DOD plans, program guidance, and F-35 performance; and we interviewed DOD, military service, and contractor officials at the headquarters' level and at many military installations that house F-35 aircraft. The reports listed on the Related Products Page provide more details on the scope and methodologies we used to carry out our prior work, including data reliability assessments.

We conducted the work on which this testimony is based in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

DOD Faces Substantial Supply Chain Challenges

First, DOD is facing substantial supply chain challenges that are hindering the readiness of the F-35 fleet. Specifically, spare parts shortages throughout the F-35 supply chain are contributing to F-35 aircraft being unable to perform as many missions or to fly as often as the warfighter requires.

The F-35's unique supply chain is central to DOD's strategy to sustain the growing fleet. Rather than owning the spare parts for their aircraft, the Air Force, Navy, and Marine Corps, along with international partners and foreign military sales customers, share a common, global pool of parts. This construct for the F-35 supply chain was intended to ease the logistical burden and provide economies of scale for the military services and international partners; however, the global pool does not have enough spare parts. Specifically, from May through November 2018, F-35 aircraft across the fleet were unable to fly about 30 percent of the time due to parts shortages, as compared with a program target of 10 percent.

Below is pictured an F-35B aircraft conducting training aboard a ship.

Figure 1: U.S. Marine Corps F-35B Conducting Training aboard the U.S.S. America



Source: U.S. Marine Corps photo by Lance Cpl. Juan Anaya. | GAO-20-234T

Our work found that several factors contribute to these parts shortages, including F-35 parts that are breaking more often than expected, and DOD's limited capability to repair parts when they break.¹ Specifically, as of April 2019, the F-35 program was failing to meet four of its eight reliability and maintainability targets—which determine the likelihood that the aircraft will be in maintenance rather than available for operations—including metrics related to part removals and part failures.² For instance, we reported at that time that the special coating on the F-35 canopy that enables the aircraft to maintain its stealth had failed more frequently than expected, and the manufacturer was unable to produce enough canopies to meet demands.³

¹GAO- F-35 Aircraft Sustainment: DOD Needs to Address Substantial Supply Chain Challenges, GAO-19-321 (Washington, D.C.: Apr. 25, 2019).

²GAO- F-35 Joint Strike Fighter: Action Needed to Improve Reliability and Prepare for Modernization Efforts, GAO-19-341 (Washington, D.C.: Apr. 29, 2019).

³GAO-19-321

These reliability challenges are exacerbated by DOD's limited capability to repair broken parts at the military depots.⁴ The capabilities to repair parts are currently 8 years behind schedule. DOD originally planned to have repair capabilities at the depots ready by 2016, but as we reported in April 2019, the depots will not have the capability to repair all parts at expected demand rates until 2024.⁵ As a result, the average time taken to repair an F-35 part was more than 6 months, or about 188 days, for repairs completed between September and November 2018—more than twice as long as planned. At that time, there was a backlog of about 4,300 spare parts awaiting repair at depots or manufacturers.

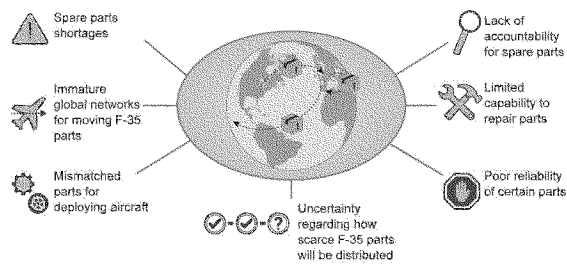
We have also reported on other challenges that DOD faces related to its supply chain, including challenges in supporting deployed F-35 aircraft around the world, in clarifying how scarce parts will be distributed, in establishing a plan for a global supply chain network, and in maintaining accountability for spare parts.⁶ Figure 2 depicts many of these and other challenges that DOD faces related to the F-35 supply chain.

⁴The F-35 sustainment strategy has a two-level maintenance concept, consisting of organizational-level maintenance, which is performed by squadron-level personnel; and depot-level maintenance. Depot-level maintenance includes structural repair, software upgrades, engine system overhaul and repair, component repair, and other activities that require specialized skills, facilities, or tooling to conduct repairs. DOD is establishing modification and repair capabilities at six military service depots in the United States as well as at additional repair facilities overseas.

⁵The F-35 program has identified 68 different repair workloads, or types of part repairs. Repair capabilities for these different workloads are projected to be in place at various dates between 2017 and 2024.

⁶GAO-19-321

Figure 2: Selected F-35 Supply Chain Challenges



Source: GAO. | GAO-20-234T

DOD has not fully implemented seven of our recommendations related to its supply chain challenges:

- Revise sustainment plans:** In October 2017, we reported that DOD's reactive approach to planning for and funding the capabilities needed to sustain the F-35 resulted in significant readiness challenges—including delays in the establishment of part repair capabilities at the depots—and placed DOD at risk of being unable to leverage the capabilities of the aircraft it had purchased.⁷ We recommended that DOD revise its sustainment plans to ensure that they include the key requirements and funding needed to fully implement the F-35 sustainment strategy.
- Conduct a comprehensive review of the F-35 supply chain:** While DOD had ongoing efforts to increase the availability of spare parts, we found in April 2019 that DOD would likely continue to face challenges because the program was not planning for the quantity of parts necessary in its spare parts projections to meet warfighter requirements. Simply purchasing more F-35 parts may not be a viable solution for DOD, given the affordability concerns the program faces. These complex problems necessitate a comprehensive approach by DOD, or it is at risk that the F-35 will not be able to conduct the full range of intended missions. We recommended that DOD conduct a

⁷GAO- F-35 Aircraft Sustainment: DOD Needs to Address Challenges Affecting Readiness and Cost Transparency, GAO-18-75 (Washington, D.C.: Oct. 26, 2017).

comprehensive review of the F-35 supply chain to determine what additional actions are needed to close the gap between warfighter requirements for aircraft performance and the capabilities that the F-35 supply chain can deliver, in light of the U.S. services' affordability constraints.

- **Develop a process to modify the afloat and deployment spare parts packages:** DOD purchases certain packages of F-35 parts years in advance to support aircraft on deployments, including on ships—called afloat and deployment spare parts packages. In April 2019, we reported that continued modifications to parts and aircraft can make such packages out-of-date by the time F-35 units deploy, and that the F-35 program did not have a process and funding in place to change out mismatched parts. This could put the military services at risk of not having the parts they need to support future deployments. We recommended that DOD develop a process to modify afloat and deployment spare parts packages, to include reviewing the parts within the packages to ensure that they match deploying aircraft and account for updated parts demand, and aligning any necessary funding needed for the parts updates.
- **Mitigate risks related to operating and sustaining the F-35 in the Pacific:** In March 2018, we issued a classified report on DOD's initial transfer of F-35s to a Marine Corps base in Japan that, among other things, described the warfighting capabilities the F-35 brought to the Pacific and assessed operational challenges the Marine Corps faced.⁸ In April 2018, we publicly reported on the recommendations from this classified report, including our recommendation that the Marine Corps assess the risks associated with key supply chain-related challenges related to operating and sustaining the F-35 in the Pacific, and that it determine how to address those risks.⁹
- **Revise the business rules for prioritizing scarce F-35 parts:** In April 2019, we reported that there was uncertainty about how the program will prioritize scarce F-35 parts among global participants. While the F-35 program had developed a set of business rules, those rules lacked clarity and detail. Absent comprehensive business rules, the F-35 program could face challenges in transparently allocating

⁸GAO-18-79C

⁹GAO, *Warfighter Support: DOD Needs to Share F-35 Operational Lessons Across the Military Services*, GAO-18-464R (Washington, D.C.: Apr. 25, 2018). DOD deemed some of the information in the March 2018 report to be classified, which must be protected from loss, compromise, or inadvertent disclosure.

parts to support competing U.S. and international requirements. We recommended that DOD revise the business rules for the prioritization of scarce F-35 parts across all program participants so as to clearly define the roles and responsibilities of all stakeholders, the process for assigning force activity designations, and the way in which deviations from the business rules will be conducted.

- **Complete a detailed plan for the establishment of the global network for moving F-35 parts:** In April 2019, we reported that DOD's networks to move F-35 parts around the world to the United States and international participants were immature. Because the F-35 program did not fully recognize the complexity of establishing a global network for moving F-35 parts, this network is now several years behind schedule and there is risk that it will not be fully capable to support an expanding fleet. We recommended that DOD complete a detailed plan for the establishment of the global network for moving F-35 parts that outlines clear requirements and milestones to reach full operational capability, and that includes mechanisms to identify and mitigate risks to the F-35 global spares pool.
- **Clearly establish how DOD will maintain accountability for F-35 parts:** In April 2019, we reported that in its rush to field aircraft and its heavy reliance on the prime contractor, DOD had not consistently followed DOD guidance for property accountability. Simply put, DOD did not have records of all the F-35 spare parts it had purchased; where those parts were located; and how much the military services had paid for them. We recommended that DOD issue a policy consistent with DOD guidance that clearly establishes how DOD will maintain accountability for F-35 parts within the supply chain, and identify the steps needed to implement the policy retrospectively and prospectively.

DOD concurred with these recommendations and has made some progress in addressing them, including issuing a revised life cycle sustainment plan in January 2019. In addition, DOD has taken actions to increase the availability of spare parts, such as efforts to improve the reliability of parts and incentivize manufacturers to repair parts.

Autonomic Logistics Information System Remains Immature

Second, DOD continues to face challenges with the F-35's Autonomic Logistics Information System (ALIS). ALIS is a complex information technology system supporting operations, mission planning, supply-chain management, maintenance, and other processes. It is intended to provide the necessary logistics tools to F-35 users as they operate and sustain the aircraft. For supply chain management, for example, ALIS is

supposed to automate a range of supply functions—including updating the status of parts, generating supply work orders, and communicating critical data about parts.

However, we reported in April 2019 that these capabilities were immature, resulting in numerous challenges and the need for maintainers and supply personnel at military installations to perform time-consuming, manual workarounds in order to manage and track parts.¹⁰ We reported that one Air Force unit estimated that it spent the equivalent of more than 45,000 hours per year performing additional tasks and manual workarounds because ALIS was not functioning as needed. In our prior work we identified several challenges associated with ALIS, including the following examples (see table 1).

Table 1: Selected Challenges Associated with the F-35 Autonomic Logistics Information System (ALIS)

Challenge	Description
Deployability of ALIS	Users reported concerns about ALIS's ability to deploy in operational environments because of the large server size and connectivity requirements.
Data accuracy and accessibility issues	Users reported concerns about data that reside within ALIS, including errors related to missing or inaccurate information about parts. DOD officials said that errors can require extensive research and troubleshooting to resolve.
Inefficient issue resolution process	Users reported that the process to resolve F-35-related issues within ALIS does not provide transparency for all action requests submitted across F-35 sites, thereby preventing users from potentially identifying timely solutions, and leaving the responsibility for resolving issues primarily with the contractor.

Source: GAO | GAO-20-234T

We have made six recommendations since 2014 to help DOD address ALIS-related challenges. DOD generally concurred with these recommendations. It addressed two by developing a plan that prioritizes ALIS risks and creating a training plan for ALIS. However, DOD has not taken action on four of our recommendations. These are:

- **Establish a performance-measurement process:** In September 2014, we reported that ALIS had experienced recurring problems, including user issues and schedule delays, and was a risk that could adversely affect DOD's sustainment strategy. But we found that DOD did not have a process to determine and address the most significant performance issues with ALIS based on user requirements, which could limit its ability to effectively and efficiently address performance

¹⁰GAO-19-321

issues and identify root causes of those issues. We recommended that DOD establish a performance-measurement process for ALIS that includes, but is not limited to, performance metrics and targets that (1) are based on intended behavior of the system in actual operations and (2) tie system performance to user requirements.

- **Incorporate cost-estimating best practices:** In April 2016, we reported that DOD's \$16.7 billion life cycle cost estimate for ALIS was not fully credible since DOD had not performed key analyses as part of the cost-estimating process. We recommended that DOD conduct uncertainty and sensitivity analyses consistent with cost-estimating best practices.
- **Ensure that future cost estimates use historical data:** In April 2016, we also reported that DOD's ALIS cost estimate was not fully accurate because DOD did not use historical cost data, including actual cost data from ALIS and data from other comparable programs. We recommended that DOD ensure that future estimates of ALIS costs use historical data as available and reflect significant program changes consistent with cost-estimating best practices.
- **Test the operation of the F-35 when disconnected from ALIS:** In March 2018, we issued a classified report on DOD's initial transfer of F-35s to a Marine Corps base in Japan that, among other things, described the warfighting capabilities the F-35 brought to the Pacific and assessed any operational challenges the Marine Corps faced.¹¹ In April 2018, we publicly reported on the recommendations from this classified report, including our recommendation that the F-35 program test operating the F-35 disconnected from ALIS for extended periods of time in a variety of scenarios, to assess the risks related to operating and sustaining the aircraft, and determine how to mitigate any identified risks.

We are currently conducting a review of ALIS, assessing how DOD is managing current and future issues related to the system. We plan to complete this review in early 2020.

¹¹GAO-18-79C

DOD Lacks Critical Information to Effectively Plan for Long-term F-35 Sustainment

Third, at the core, DOD's current sustainment challenges have largely resulted from insufficient planning. We have found that DOD lacks information about the technical characteristics and costs of the F-35, which will impair its ability to plan for the long-term sustainment of the F-35 fleet.

The current F-35 sustainment strategy states that the primary contractor will provide logistics support for the aircraft.¹² In October 2017, we reported that while DOD planned to enter into 5-year, fixed-price, performance-based contracts with the prime contractor in the next few years, DOD did not have full information on F-35 technical characteristics or costs to enable it to effectively negotiate those contracts. Specifically, certain technical aspects of the aircraft remained immature or uncertain, including reliability measures that are lagging behind operational requirements.¹³ As previously discussed, in April 2019 we reported that the F-35 program was still not on track to meet its targets for four out of eight reliability and maintainability metrics, and that the program had not taken adequate steps to ensure that those targets would be met. DOD officials told us that there would be inherent risk in signing a long-term, performance-based contract before reliability and maintainability data were more fully known, as those data would influence how much aircraft performance should cost.

In addition, DOD did not have full visibility into the actual costs of some key sustainment requirements that are considered cost-drivers within the program, such as the actual costs of parts and repairs. Thus, DOD had relied on projected parts reliability and pricing to formulate cost estimates. Actual costs of sustainment requirements can change significantly from initial projections. For instance, we reported that, between the program's 2014 and its 2015 estimates, the costs of initial spare parts over the life cycle increased by \$447 million. The lack of cost information continues to be a challenge for DOD, as we reported in April 2019.¹⁴ DOD officials have stated that they need to know actual costs in order to improve both their confidence in the estimates and their understanding of how cost is related to performance.

¹²For the purposes of this testimony, the term "prime contractor" refers to Lockheed Martin, as it is the prime contractor for the aircraft and provides overall system integration. Pratt & Whitney is the contractor for the engine of the F-35.

¹³GAO-18-75

¹⁴GAO-19-321

Below is pictured an F-35A aircraft being refueled.

Figure 3: Refueling of an F-35A



Source: U.S. Air Force photo by R. Nial Bradshaw. | GAO-20-234T

Further, DOD lacks the technical data from the prime contractor needed to fully understand the technical characteristics of the F-35 aircraft and enable potential competition of future sustainment contracts. Technical data include the blueprints, drawings, photographs, plans, instructions, and other documentation required to adequately produce, operate, and sustain weapon systems. Technical data are critical for weapon systems such as F-35 aircraft, as they provide DOD with the information necessary to support the fleet. In April 2019, we found that challenges related to readiness and costs were driving DOD to begin to develop an option for DOD-led supply chain management as a potential alternative to the performance-based contracts through which the prime contractor would provide logistics support.¹⁵ The DOD-led option would require the department to obtain significant amounts of technical data on F-35 parts from the manufacturers of those parts; however, at that time DOD was facing challenges in obtaining the needed data.

¹⁵GAO-19-321

DOD has not fully implemented 10 of our recommendations related to these issues:

- **Develop a long-term Intellectual Property strategy:** In September 2014, we reported that DOD had not identified all of the technical data it needs from the contractor, and at what cost, to enable competition of future sustainment contracts, which put the program at risk of not having the flexibility to make changes to its sustainment strategy. We recommended that DOD develop a long-term Intellectual Property strategy to include, but not be limited to, the identification of current levels of technical data rights ownership by the federal government and all critical technical data needs and their associated costs.
- **Assess whether the program reliability and maintainability targets are still feasible:** In April 2019, we reported that the F-35 program continued to fall short of meeting performance targets for half of its reliability and maintainability metrics. Program officials said that those targets need to be reevaluated to determine more realistic performance targets, but they had not taken action to do so. We recommended that DOD assess whether the program's reliability and maintainability targets are still feasible, and revise accordingly.
- **Identify specific and measurable reliability and maintainability objectives:** In April 2019, we reported that the F-35 program's plan for improving reliability and maintainability did not address the four under-performing metrics. Specifically, the guidance the program has used to implement this plan does not define specific, measurable objectives for what the desired goals for F-35 reliability and maintainability performance should be. As long as these metrics continue to fall short, the military services may have to settle for aircraft that are less reliable and more costly to maintain than originally planned. We recommended that DOD identify specific and measurable reliability and maintainability objectives in its guidance.
- **Link reliability and maintainability improvement projects to the associated objectives:** In April 2019, we reported that the F-35 program had not aligned its planned reliability and maintainability improvement projects with reliability and maintainability goals, which could put the program at risk of not meeting those goals. We recommended that DOD identify and document in guidance which reliability and maintainability improvement projects will achieve the identified objectives.
- **Prioritize funding for reliability and maintainability improvement:** In April 2019, we reported that the F-35 program office had estimated potential life-cycle cost savings of more than \$9.2 billion from

implementing the reliability and maintainability improvement projects in its plan, but had not prioritized or dedicated funding in its budget necessary to carry out the projects. As a result, projects had been prematurely suspended or delayed. We recommended that the F-35 program office prioritize funding for the reliability and maintainability improvement plan.

- **Re-examine the metrics DOD will use to hold the contractor accountable:** In October 2017, we reported that DOD might not be using the appropriate performance metrics under trial performance-based agreements to achieve desired outcomes or hold the contractor accountable for performance. We recommended that DOD re-examine the metrics that it will use to hold the contractor accountable under the fixed-price, performance-based contracts, to ensure that such metrics are objectively measurable, are fully reflective of processes over which the contractor has control, and drive desired behaviors by all stakeholders.
- **Delay entering into multi-year, fixed-price, performance-based contracts:** In October 2017, we reported that DOD was moving quickly toward negotiating longer-term performance-based contracts without a sufficient understanding of the actual costs and technical characteristics of the aircraft, which put DOD at risk of overpaying for sustainment support that is not sufficient to meet warfighter requirements. We recommended that, before DOD enters into multi-year, fixed-price, performance-based contracts, it ensure that it has sufficient knowledge of the actual costs of sustainment and technical characteristics of the aircraft at system maturity.
- **Obtain comprehensive cost information for F-35 spare parts:** In April 2019, we reported that DOD did not have comprehensive cost information for individual F-35 spare parts, and that it faced challenges in obtaining this information from the prime contractor. This lack of cost information impedes DOD's ability to develop a complete understanding of the costs for the F-35 system and to effectively negotiate with the prime contractor for sustainment support. We recommended that DOD develop a methodical approach to consistently obtain comprehensive cost information from the prime contractor for F-35 spare parts within the supply chain.
- **Formalize a methodology for recording military service funds spent on F-35 parts:** In April 2019, we reported that the military services could not track the funds that they had spent for the purchase of F-35 spare parts to the actual parts on their financial statements, thereby hindering DOD's financial improvement and audit readiness efforts. We recommended that DOD complete and

formalize a methodology for the U.S. services to use in recording on their financial statements the funds spent on F-35 parts within the global spares pool.

- **Clearly define the F-35 supply chain management strategy:** In April 2019, we reported that DOD was caught between two distinct sustainment concepts—the program's official contractor-provided logistics support construct and DOD's effort to develop options for DOD-led supply chain management. Until DOD clearly defines its strategy for managing the F-35 supply chain in the future, the F-35 program will lack the certainty and unity of effort necessary to meaningfully improve supply chain performance and reduce costs. We recommended that DOD clearly define the strategy by which it will manage the F-35 supply chain in the future and update key strategy documents accordingly, to include any additional actions and investments necessary to support that strategy.

DOD concurred with all of these recommendations. Seven of the preceding recommendations were made earlier this year, and we recognize that it will take time for DOD to implement them. However, DOD's attention to each of these recommendations is important to improving its long-term sustainment planning.

In summary, DOD's costs to purchase the F-35 are expected to exceed \$406 billion, and the department expects to spend more than \$1 trillion to sustain its F-35 fleet. Thus, DOD must continue to grapple with affordability as it takes actions to increase the readiness of the F-35 fleet and improve its sustainment efforts to deliver an aircraft that the military services and partner nations can successfully operate and maintain over the long term within their budgetary realities. DOD's continued attention to our recommendations will be important as it balances these goals. We will continue to monitor DOD's efforts to implement our recommendations.

Chairmen Garamendi and Norcross, Ranking Members Lamborn and Hartzler, and Members of the Subcommittees, this completes my prepared statement. I would be pleased to respond to any questions that you may have at this time.

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Acknowledgments**

If you or your staff have questions about this testimony, please contact Diana Maurer, Director, Defense Capabilities and Management, at (202) 512-9627 or maured@gao.gov.

Contact points for our offices of Congressional Relations and Public Affairs may be found on the last page of this statement. GAO staff who made key contributions to this testimony are Alissa Czyz and Kasea Hamar (Assistant Directors); Jon Ludwigson, Vincent Buquicchio, Tracy Burney, Desiree Cunningham, Jeff Hubbard, Justin Jaynes, Amie Lesser, Sean Manzano, Jilena Roberts, Michael Silver, Maria Staunton, Tristan T. To, Cheryl Weissman, and Elisa Yoshiara.

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Diana Maurer is a Director in the U.S. Government Accountability Office's (GAO) Defense Capabilities and Management team, where she currently leads GAO's work overseeing defense sustainment issues. Her recent work includes reviews of the F-35 global supply chain, workforce challenges at military depots, DOD's supply chain management, and software sustainment in major weapon systems. She has testified more than two dozen times before Congressional committees on a variety of issues including national drug control policy, DOJ oversight, FBI's use of facial recognition technology, and various management issues at DHS.

Ms. Maurer was a Director in GAO's Homeland Security and Justice team from 2009-2017, where she led GAO's oversight of the federal prison system; the Secret Service, FBI and other federal law enforcement agencies; DOJ grant programs; the federal courts system; and DHS's efforts to build a unified department. She worked from 2008-2009 as an Acting Director in GAO's Natural Resource and Environment team, where she led work assessing U.S. global nuclear detection programs. From 1993-2007, Ms. Maurer worked in GAO's International Affairs and Trade team, where she led reviews of U.S. efforts to combat international terrorism and proliferation of weapons of mass destruction, U.S. assistance to the former Soviet Union, peacekeeping in the Balkans, and several other international issues. Ms. Maurer began her GAO career in 1990 in GAO's Detroit Regional Office.

Ms. Maurer has an M.S. in national resource strategy from the National Defense University where she was recognized as a Distinguished Graduate of the Industrial College of the Armed Forces. Ms. Maurer also has an M.P.P in international public policy from the University of Michigan and a B.A. in international relations from Michigan State University.

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STATEMENT OF

HONORABLE ELLEN M. LORD
UNDER SECRETARY OF DEFENSE FOR ACQUISITION AND SUSTAINMENT

BEFORE THE
TACTICAL AIR AND LAND FORCES SUBCOMMITTEE
AND READINESS SUBCOMMITTEE
OF THE
HOUSE ARMED SERVICES COMMITTEE

ON

F-35 LIGHTNING II PROGRAM SUSTAINMENT

NOVEMBER 13, 2019

NOT FOR PUBLICATION UNTIL RELEASED BY
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I Introduction

Chairman Norcross, Ranking Member Hartzler, and distinguished members of the Tactical Air and Land Forces Subcommittee and Chairman Garamendi, Ranking Member Lamborn, and distinguished members of the Readiness Subcommittee, thank you for the opportunity to testify today.

I am pleased to join the Director of Operational Test and Evaluation, Robert Behler, the F-35 Joint Program Office Program Executive Officer, Lieutenant General Eric Fick, and Diana Maurer, the GAO Director of Defense Capabilities and Management to discuss our continued efforts to develop, build, and sustain an affordable and ready F-35 Air System capable of dominating the 21st Century battlespace.

I am here representing the entire Acquisition and Sustainment team of over 100,000 dedicated military, civilian, and contractor professionals who execute our mission every day. I am proud and impressed with the work these dedicated professionals do every day to provide the materiel solutions that give our warfighters the capabilities they need to meet the security challenges we see around the world. In particular, I want to commend the work of the entire F-35 team for their efforts to drive fifth Generation Tactical Aircraft Capabilities to our U.S. Services, International Partners, and Allies.

With more than 458 fielded F-35 aircraft operating from within the U.S. and abroad, our warfighters are beginning to experience the true game changing capabilities the F-35 brings to bear, as well as identifying challenges that need to be addressed. Through these efforts, along with the aggressive implementation of cost-saving initiatives, the F-35 will be more survivable, supportable, lethal, and affordable than ever before.

As Under Secretary, I have maintained a laser focus on driving down costs, improving quality, and increasing fleet readiness. I have worked with these dedicated professionals to help transform the F-35 Program to shift it from a development and initial production focused enterprise to one that delivers the efficiencies and throughput we must have in full rate production. We are also evolving into an agile enterprise that delivers war winning capabilities at a speed that meets the challenge of quickly evolving adversaries. The F-35 Enterprise will make this transformation while delivering the readiness outcomes that our customers demand in a time of strategic competition.

Before taking your questions, I would like to walk through how the F-35 enterprise is working to dramatically improve F-35 sustainment outcomes. I will frame my remarks around those outcomes the Department, F-35 Joint Program Office (JPO), and the U.S. Services are all driving to achieve: Improving Aircraft Availability and Reducing Sustainment Costs.

II Improving Aircraft Availability

As the F-35 fleet continues to grow and the Air System's capabilities are enhanced, it is crucial we stay focused on improving fleet readiness to ensure the F-35's critical capabilities are available to the warfighter. I would like to thank the Congress for their support in helping us maintain this balanced investment approach. With your help, the F-35 Program continues to make steady progress to support fleet readiness enhancement activities including:

- Improving overall F-35 sustainment outcomes and aircraft readiness despite dramatic fleet size increases. By the end of 2019, the F-35 Enterprise is on track to produce nearly 150% more aircraft than we built just two years ago and 50% more than in 2018. As the F-35 fleet has grown, aircraft readiness has improved. In particular, DoD combat-coded operational unit Mission Capable (MC) performance increased from 55% in October

2018 to 73% in September 2019; USMC F-35B MC rates increased from 44% to 68%; USAF F-35A rates jumped from 66% to 75%; and USN F-35C rates rose to 75% over the same period.

- Accelerating Reliability and Maintainability (R&M) improvement efforts have contributed to a fleet-wide MC rate increase of 2.7%. To date 161 projects have been identified, with 68 completed.
- Procuring spares and supplies which has helped decrease Non-Mission Capable-Supply (NMCS) rates by 5% during fiscal year 2019.
- Accelerating the activation of organic depot repair capacity, a critical readiness driver, by 6-years, from 2030 to 2024. By the end of this year, 30 of 68 depot repair lines will be activated, one more than the Department's plan had forecasted. We have also reduced total repair time of parts by 13% and are working the continued implementation of performance based agreements and master repair agreements with our industry partners.

Despite our vigilant efforts to improve F-35 sustainment, challenges remain. As I shared previously, the Department issued a program deviation last month due to delays in integrating the F-35 into the Joint Simulation Environment test infrastructure. Additionally, other issues continue to hamper the F-35 Program's ability to achieve the F-35 fleet availability standards required by our warfighters. However, I want to reiterate that I have full faith and confidence in the F-35 program, and in our ability to deliver F-35 combat capability anywhere in the world. Make no mistake, the F-35 is the world's most advanced, lethal, and interoperable aircraft ever developed.

In order to tackle our most pressing sustainment challenges, my Assistant Secretary of Defense for Sustainment, Bob McMahon, approved a new F-35 Life Cycle Sustainment Plan

(LCSP) in January 2019 that identified the success elements that we are employing to drive F-35 availability to meet the sustainment goals required by the U.S. Services, our International Partners, and our Foreign Military Sales (FMS) customers. These success elements address key improvement areas to include:

- Accelerate fleet modifications to upgrade early production aircraft and improve reliability
- Secure Technical Data to spur on competition and provide additional organic repair flexibility
- Identify future maintenance plan changes and accelerate current Top Five capabilities
- Accelerate Navy Intermediate-Level Maintenance for remote shipboard operations
- Accelerate Supply Chain improvements to increase enterprise supply posture and reduce NMC rate for Supply
- Further accelerate depot component repair workload activations to increase supply posture
- Improve Autonomic Logistics Information System (ALIS) field level functionality and responsiveness
- Enhance Reliability and Maintainability Improvement Program (RMIP)
- Accelerate Software Modernization with Government organic core capability

Led by the F-35 JPO's Product Support Manager (PSM), a joint team of representatives from OSD, the F-35 JPO, U.S. Services, and Industry have made great progress in their work to define the plans, metrics, and timelines for each of the success elements. Moreover, Bob McMahon personally provided direct oversight for the development of these plans, and I thank him for his leadership. I'd like to highlight how we think about some of these success elements.

Accelerate Supply Chain Improvements: The Department is focused on delivering Warfighter performance capability within resource constraints. Integral to enabling this is addressing supply chain management inefficiencies and risk. The F-35 Program is driving supply chain improvements through their implementation of a Global Support Solution (GSS) to enable the affordable maintenance and sustainment of combat-ready F-35 capabilities worldwide. For example, the Department is increasing spare parts availability within the GSS by increasing supplier capacity, decreasing lead times for spares, and optimizing shelf spares. Additionally, the Department is continually taking action to assess and develop alternative sourcing of suppliers to ensure that our supply chain is robust and resilient in a dynamic geopolitical environment. Moreover, efforts like these will improve our supply chain performance and result in improved MC rates.

Accelerate Depot Component Repair Workload Activations: Organic depot component repair capability is integral to the readiness of the fleet as it will help support the F-35 global supply chain with ready-for-issue components at a rate that meets fleet demand. Organic depot repair capability will continue to mature over the next eight to ten years until the program achieves full depot capability. By 2024, U.S. depots will have a “demand-rate” repair capability for all sixty-eight workloads to include adequate facilities, trained labor, current technical data, and repair material on hand to affect efficient repairs. Sequencing of workload activations has been prioritized to have the highest positive impact on fleet readiness. The Department is working to ensure that, as new capabilities are introduced into the fleet in Block 4 and beyond, we are conducting appropriate planning to stand up organic depot repair capability where needed to meet fleet demand.

Improving ALIS Field-Level Functionality and Responsiveness: The F-35 ALIS is a key enabler to the platform's operational availability and capability. The Department recognizes that ALIS, as presently constituted, is not delivering the capabilities the Warfighter needs. To correct this, the Department has a plan to stabilize and add critical capabilities to the current version of ALIS and we are starting to see progress from these efforts. Over the past year, the Department has delivered three ALIS software updates and we are on-track to release quarterly releases to rapidly improve current performance – a vast improvement from the 18 months between software updates in the past. Our efforts to stabilize and improve the usability of ALIS has driven trouble reports down 38% from their peak. These efforts mitigate risk while the Department charts a path to the future of ALIS that will help deliver a more ready fleet at a lower cost.

The Department is currently building a timeline with discrete milestones that will chart a management path towards delivering the next-generation ALIS. The new ALIS system will enable the Department to utilize agile software development techniques to deliver flexible applications on a modern, secure architecture. The Department is leveraging the abundance of ALIS lessons learned while embedding together Government and Industry developers along with close partnering with the user to establish a new agile development culture. With that knowledge and culture change, we will deliver a less man-power intensive next-generation ALIS system capable of driving the readiness and affordability we need across the air system. Progress will be driven by our access and understanding of the underlying data and our close partnership with industry. I see a number of our industry partners demonstrating a high degree of competence in developing the kinds of secure, flexible, and open architectures needed to deliver the capabilities the warfighter needs. The problems with ALIS are ones we can and must solve.

Accelerate Software Modernization with Government organic core capability: The Department will likely sustain F-35 software for over 50 years, so implementing a strategy to do this in an affordable and agile way is critical for our warfighters. The program has developed a strategy to merge software development and sustainment of the F-35 Air System supported by an integrated team from Industry, U.S. Government, and International Partners. Agile and DevSecOps are key enablers of this strategy. Two U.S. Air Force and two U.S. Navy organic software depots are being activated to meet the Department's and U.S. Service's readiness (sustainment capacity) and affordability goals.

To accelerate the Agile and DevSecOps enablers for Software Modernization, an effort began in August 2019 to move all F-35 software development to a JPO Government Cloud. That effort is progressing and includes the full support of key industry partners Lockheed Martin and Pratt & Whitney. Our first proof of concept developing F-35 Air System software in the JPO Government Cloud is planned to complete by 1 February 2020.

III Reducing Sustainment Costs

The F-35 Enterprise recognizes that the U.S. Services, the F-35 JPO, and Industry must collaborate to reduce sustainment costs. As we continue to work towards improving and maintaining a high-rate of MC across the fleet, we are making measured progress towards improving F-35 fleet affordability. For example, the estimated cost per flying hour of the F-35B in 2019 decreased by 6 percent corresponding with a drop in the cost of operating the F-35Bs by approximately \$500,000 per tail per year in 2019. In addition, we have reduced F-35 Life Cycle Costs by an estimated \$2.7 billion by accelerating R&M improvements.

Despite these projections, we recognize that there is much more work to be done and this work needs to be accelerated. Consequently, the Department documented new, Service-budget

informed affordability constraints for F-35 sustainment in an Acquisition Decision Memorandum I signed late last year. These affordability constraints, developed by the U.S. Services, for the first time define what the Services will be able to afford to spend on F-35 sustainment, based on projected future budget and portfolio prioritizations. These constraints are a management tool around which all of our efforts to reduce sustainment cost are organized.

More specifically, I am personally overseeing a collaborative effort by the Department, F-35 JPO, Lockheed Martin, and Boston Consulting Group to understand the barriers preventing more rapid improvements to both readiness and affordability performance. The intent is for the F-35 Program to apply commercial best practices to targeted interventions to accelerate performance improvements. These efforts continue to provide granular insights into sustainment cost drivers, which will enable more targeted and efficient cost reduction efforts. Specifically, we have identified that driving down sustainment support costs, both in terms of labor cost and labor demand, is the key lever in reducing overall F-35 sustainment costs, because sustainment support accounts for over a third of overall sustainment costs.

The Department is using these insights to pivot towards an action-oriented and integrated engagement model to support accelerated implementation of key success factors identified in our LCSP. In particular, these insights are assisting our efforts to drive sustainment improvements across the entire F-35 Enterprise in the following areas:

- Improve supplier relations—supports upcoming contractual discussions with targeted analytical support;
- Support LCSP acceleration—outlines discrete tasks, goals, specify timelines to promote measurable improvement;

- Address ALIS—provides technical advisory and establish strong governance across existing programs.

Finally, as we learn more about the readiness barriers and the cost drivers that we need to collectively knock down to meet our affordability goals, we're using this knowledge to help inform our analysis of Lockheed's proposal for a 5-year, fixed price Performance Based Logistics (PBL) contract. The Department has convened a Joint Independent Assessment Team to evaluate the merits and impacts of any potential PBL approach. This Tri-Service team led by Secretary Geurts is in the early stages of working, in conjunction with our industry partners, to analytically understand when, or if, an F-35 PBL contract could be awarded. Our goal is to ensure that any such contract meets the readiness and affordability goals important to the F-35 warfighter and is in the best interest of the American taxpayer.

IV Conclusion

The Department continues to demonstrate our commitment to provide an affordable, lethal, supportable, and survivable F-35 air system to the warfighter. These accomplishments are made possible by the strong partnerships that exist within the F-35 Enterprise, both across U.S. Services and among our International Partners and FMS customers. As the F-35 Program continues to make steady progress to improve sustainment, the Department is aggressively tackling the challenges I described above. We will continue to work to resolve these issues and provide a clear status of our progress to our Congressional stakeholders as well as senior DoD and International leadership.

While the Department is grateful to the Congress for passing a two-year budget agreement that provides the budgetary certainty the Department needs to implement the National Defense Strategy, I want to reiterate how regrettable it is that we are again under a Continuing Resolution

(CR). CRs cause great damage to military readiness and disrupt our ability to modernize our strategic forces, including nuclear, for the future. I strongly urge Congress to pass a defense appropriation and authorization bill now so that we can move forward with the many important programs needed to ensure our readiness and deter our adversaries.

I want to thank both Subcommittees for your longstanding, bipartisan support to our F-35 Program and the men and women in uniform who make it the premier multi-mission, fifth-generation strike fighter that provides our warfighters unmatched, game-changing capabilities. I look forward to your questions.

Ellen M. Lord
Under Secretary of Defense for Acquisition and Sustainment

Senate Confirmed in August 2017, the Honorable Ellen M. Lord currently serves as the Under Secretary of Defense for Acquisition and Sustainment (A&S). In this capacity, she is responsible to the Secretary of Defense for all matters pertaining to acquisition; developmental testing; contract administration; logistics and materiel readiness; installations and environment; operational energy; chemical, biological, and nuclear weapons; the acquisition workforce; and the defense industrial base.

Prior to this appointment, from October 2012 – June 2017, Ms. Lord served as the President and Chief Executive Officer of Textron Systems Corporation, a subsidiary of Textron Inc. In this role, she led a multi-billion dollar business with a broad range of products and services supporting defense, homeland security, aerospace, infrastructure protection, and customers around the world.

Ms. Lord has more than 30 years of experience in the defense industry, serving in a variety of capacities, to include Senior Vice President and General Manager of Textron Defense Systems, now Weapon & Sensor Systems; and Senior Vice President and General Manager of AAI Corporation, now known as Textron Systems' Electronic Systems, Support Solutions, and Unmanned Systems businesses. Earlier in her career, Ms. Lord served as Vice President of Integration Management for Textron Systems and Vice President of Intelligent Battlefield Systems for Textron Defense Systems, in addition to other business and operations positions.

Ms. Lord is a former Vice Chairman of the National Defense Industrial Association, as well as a former Director of the U.S. – India Business Council. She has served on the industry steering committee for the Center for New American Security's (CNAS) task force on "Strategy, Technology and the Global Defense Industry," as well as CNAS's DoD-Industry collaborative project "Future Foundry: Forging New Industries for Defense," which was formed to examine key technological trends and challenges facing the global defense industry. Ms. Lord has also served on the Board of Trustees of the U.S. Naval Institute Foundation.

Ms. Lord earned a Master of Science degree in chemistry from the University of New Hampshire, as well as a Bachelor of Arts degree in chemistry from Connecticut College.

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THE U.S. HOUSE OF REPRESENTATIVES

STATEMENT OF

LIEUTENANT GENERAL ERIC FICK
PROGRAM EXECUTIVE OFFICER
F-35 LIGHTNING II PROGRAM

BEFORE THE

READINESS AND TACTICAL AIR LAND FORCES SUBCOMMITTEES

OF THE

HOUSE ARMED SERVICES COMMITTEE

ON

F-35 PROGRAM UPDATE: SUSTAINMENT, PRODUCTION, AND AFFORDABILITY
CHALLENGES

NOVEMBER 13, 2019

NOT FOR PUBLICATION UNTIL RELEASED BY
THE U.S. HOUSE OF REPRESENTATIVES

I Introduction

Chairmen Garamendi and Norcross, Ranking Members Lamborn and Hartzler, and distinguished Members of the Subcommittees, thank you for this opportunity to discuss the status and future of the F-35 Lightning II Program. First, please allow me to extend a sincere “Thank You” for your support of the F-35 program and the authority for Economic Order Quantity procurement for production lots 15-17 in the National Defense Authorization Act for Fiscal Year 2020.

Since the last time F-35 program leadership appeared before this committee, we have continued to simultaneously execute along the Development, Production, and Sustainment lines of effort that are critical to the present and future of this Air System and the Joint and International warfighters that depend on it for their nation’s safety, security, and stability. The game-changing capability the F-35 brings to the fight demonstrates the value of effective U.S. and global strategic partnerships. I am proud to represent the F-35 Enterprise and to inform you of the progress we’ve made in modernizing and sustaining this aircraft now deployed in combat operations around the world. My team, together with our industry partners, continues to aggressively pursue mission critical operational requirements for this tri-service, international 5th generation air system ensuring that it remains relevant in an ever-changing threat environment. From a modernization perspective, Block 4 is the key set of capabilities that will define the F-35 in the 2020s, and we are diligently and incrementally working to deliver it today. Our work with the U.S. Services and the Department to understand future threats and assess additional future required capabilities is a rigorous and constant process. By establishing a Capability Verification environment in which our newly-developed capabilities may be demonstrated to be effective, the Development foundation being put in place as part of our Block

4 efforts will provide the bedrock for the continuous delivery of these future capabilities, based on requirements and U.S. Services prioritization and future allocated resources.

As evidenced recently with the award of F-35 Production Lots 12-14, we continue to drive down production costs, delivering increasing numbers of new production aircraft to our domestic and international partners, and making wholesale improvements to the readiness and sustainment posture of the growing global fleet. As of today, our effective and “combat proven” F-35 Air System beddown includes more than 458 air systems delivered, eight Initial Operating Capability (IOC) declarations, 11 First Aircraft Arrivals across nine nations and F-35s operating at 18 bases around the globe.

II Driving Change in the Right Direction...Sustainment costs down, MC rates up

As the operational fleet grows, we must continue to emphasize affordability as we mature our Global Sustainment Solution and drive reductions in current and future Operating and Support (O&S) costs. While much work remains ahead of us, the program is demonstrating a downward glideslope in O&S costs. In 2019 alone, the program realized a nine percent reduction in Cost Per Flying Hour (CPFH) when compared to last year’s numbers.

We’ve also seen improvements in our Aircraft Mission Capable (MC) rates. Actions undertaken by the F-35 Enterprise and by our warfighting maintainers in 2019 increased the MC rate of our operational fleet from 54.7% in October of 2018 to 72.5% in September of 2019. Across the services, over the same time period, the U.S. Air Force increased from 66% to 75% MC for the F-35A, the U.S. Marine Corps increased from 44% to 68%, and the U.S. Navy achieved 75%. This summer, forward deployed USAF units from Hill Air Force Base in Utah reported MC rates above 80% since July with recent Full Mission Capability (FMC) rates of 89% and 92% in September and October, respectively.

Much of this progress is due to actions the F-35 Enterprise has implemented as a result of the publication and execution of our 2019 Life Cycle Sustainment Plan (LCSP), but an equal amount of credit goes to the Airmen, Marines, and Sailors maintaining the F-35 Air System in the field. There has been much debate as to which actions best drive improvements in cost and capability metrics, for our maintainers. We have come to realize there is no silver bullet in this arena; a coordinated effort across a wide spectrum of initiatives is required. For the F-35 Enterprise, this coordinated effort is articulated in the F-35 Life-Cycle Sustainment Plan (LCSP). Even though this plan was only signed earlier in 2019 we already are seeing tangible benefits from the synergies across the Success Elements of this plan and evidence, through metrics, that they are driving down O&S costs and improving aircraft availability.

To measure our performance and align with the Services needs and funding levels, the F-35 JPO established near-term targets to measure progress towards these through the FYDP and beyond. These targets are:

- i. F-35A: \$4.1M CPTPY (CY12\$), across 2036-41, achieve by 2036*
- ii. F-35B: \$6.8M CPTPY (CY12\$), across 2033-37, achieve by 2033*
- iii. F-35C: \$7.5M CPTPY (CY12\$), across 2036-43, achieve by 2036*
- iv. F-35C: \$25.2K CPFH (CY12\$), same timeframe as above*

The LCSP also contains a stretch goal measure of \$25K CPFH by 2025 for the F-35A (CY12\$). Current estimates for DoD F-35 CPFH shows a projection of \$32.2K in 2024 and \$30.7K in 2025 (CY12\$) and for the F-35A a projection of \$32.5K in 2024 and \$31.7K in 20-25 (CY12\$). The difference between this estimate of \$31.7K and the stretch goal of \$25K by 2025 reflects the work we have to do as a global Enterprise. The F-35 Program is tracking progress to the Success Elements of the LCSP through a set of primary metrics (those CPTPY and CPFH

targets listed above) and lower-level supporting metric data, which include the following rates: Mission Capable, Full Mission Capable, Out of Reporting, Non-Mission Capable and Non-Mission Capable Maintenance. The Success Elements identified in the LCSP are the key enablers to the program's overall ability to meet these targets and continue on a path to driving O&S cost down while improving aircraft availability. These elements are highlighted below:

Accelerate Fleet Modifications: The expedited completion of Non-Recurring Engineering, Material Procurement and Installation of components is on track to provide the warfighter the required capability to meet mission needs. An expedited plan was formalized and agreed to by the Services, Partners, and Foreign Military Sales Customers this past June. Today, all associated contract actions required to execute the 15-month acceleration of the Tech Refresh-2 (TR-2) upgrade have been awarded. To date, 45 of the 94 planned TR-2 upgrades are already complete with the remaining installations on track to complete in September 2020.

Accelerate Intermediate Level Maintenance and Maintenance Plan Changes: A minimum of 27 maintenance plan changes will be executed, giving our Airman, Sailor, and Marine maintainers the ability to perform maintenance tasks that today are restricted to contractor personnel. These changes better align the F-35 sustainment Enterprise with the more familiar organic approach in support of the warfighter, with an additional benefit of a total estimated life cycle cost avoidance of \$245M. A clear example of putting our maintainers first is a new set maintenance plans that will enable Navy maintainers at sea aboard a U.S. Navy aircraft carrier to execute intermediate-level avionics maintenance actions onboard rather than shipping the part or component to a Military Service Depot or Original Equipment Manufacturer as required today.

Accelerate Supply Chain Capability: The F-35 Sustainment Supply enterprise continues to mature while supporting the warfighter with a focus on delivering and improving affordable fleet

readiness. The percentage of the fleet non-mission-capable awaiting spare parts (NMC-S) increased through early 2019, but has steadily decreased since summer. As of October 2019, the NMC-S rate was under 15% for our operational fleets and 24% for our non-operational, testing and training fleets. The fraction of time that our maintainers found the part they needed on the shelf when they needed it remained steady through 2019 and our ability to provide the maintainer with a part not readily available on base improved by 26%.

We have reduced the total repair time of parts by 13%, continue to accelerate the implementation of Performance Based Agreements and Master Repair Agreements with commercial repair providers, and have accelerated the stand-up of organic depots. In line with the LCSP, the program is accelerating spares deliveries through targeted supplier engagement, enhanced tools for proactive actions, and streamlined integration efforts between the sustainment teams and supply chain management. Sustainment Supply performance of the propulsion system through FY19 has exceeded resourced targets with a NMC-S rate of 2% for modules and piece parts combined.

As an enterprise, our contracts are transitioning away from ones that feature purely cost-focused incentives and now feature incentive structures to drive contractor behavior. For development efforts, these incentives facilitate the early transition to Agile-enabled processes. Our production contracts – including the Lot 12-14 contract – feature Supplier Incentive Fees and Performance Incentive Fees that drive cost reduction at the supplier level and improve production line velocity. Our sustainment contracts incentivize MC rates and supplier metrics that ensure our warfighters have the aircraft they need when they need them.

We also continue to look for ways to improve the business relationships with our industry partners, enabling them to make better deals on our behalf and driving better program outcomes.

Some of our ongoing efforts include potential multiple year and multi-year contracts for production, and Performance-Based Logistics – or PBL – contracts for sustainment. In fact, we are working today with Lockheed Martin to define the parameters of a Sustainment PBL that meet our warfighter’s operational demands, our taxpayers’ best value demands and our Enterprise’s demands for greater organic involvement in F-35 sustainment.

Accelerate Depot Repair Capability: Throughout 2019 we have supported more than 60 deployments around the globe, to include operational and non-operational theatres. Our effort to increase the supply chain continues as we stand-up new F-35 bases and establish new Transfer Locations to get spare parts to the warfighter, wherever they are operating.

In 2019, the program leveraged the organic power of the U.S. Services and U.S. Government agencies and began transitioning warehousing and transportation workloads. In 2020, the Defense Logistics Agency (DLA) will manage F-35 warehousing and U.S. Transportation Command (TRANSCOM) will manage 90% of the transportation requirements for the program. Finally, by the end of CY20 we project all sustainment contracts will be operating in a multiple year environment, enabling a cost savings by incentivizing investment for long-term outcomes.

In 2020 we will leverage the warehousing capacity of the U.S. Defense Logistics Agency (DLA) in North America and the world-wide transportation and distribution capacity of the both DLA and TRANSCOM through the Joint Deployment and Distribution Enterprise. At the end of October, the Program declared Initial Operating Capability (IOC) of our F-35 European Regional Warehouse in the Netherlands, the first OCONUS regional warehouse. In 2020 we will stand-up an Asia-Pacific Regional Warehouse in Australia, which will continue to improve our supply chain responsiveness by reducing transportation times to our Services, Partners and Customers in that region. The Global Sustainment Solution is truly coming to life.

Depot Activations for Air Vehicle and Engine Line Replaceable Units (LRU) in 2019 were ahead of schedule with 28 Air Vehicle workloads activated so far and two more to follow by the end of the year, and 16 Engine LRUs have been activated. In addition, the first OCONUS Air Vehicle Regional Maintenance, Repair, Overhaul and Upgrade (MRO&U) operation in Cameri, Italy declared Initial Depot Capability (IDC).

We are also beginning the activation phase of six additional Air Vehicle LRU workloads, bringing total activations to 36 at the end of 2020, of 68 planned core workloads to be completed by 2024- six years earlier than originally planned. In addition, the Air Vehicle Regional MRO&Us in Australia and Japan, and the Propulsion Regional MRO&Us in Australia and the Netherlands will activate in 2020.

Improve ALIS Sustainment Functionality & Responsiveness: The ALIS 3.0 software release in the fall of 2018 met the required capabilities under the System Design and Development (SDD) Phase of the F-35, and ALIS currently performs all functions supporting the F-35 Sortie Generation Process today.

With that said, I also recognize that the current ALIS system requires significant additional improvements to enable improved operational and supportability outcomes. We are therefore shifting the ALIS development strategy. This means we are pivoting to agile development, then racing to a minimum viable system, where teams deliver enough features to satisfy our users and learn from their feedback early in the development process. With the delivery of the ALIS 3.5 capability this month, we anticipate there will be no further major releases on the legacy ALIS system, only minor enhancements as required. Block 4 ALIS capabilities will be rolled into a government managed backlog, and we will focus on delivering a modern maintenance system. To pivot to an agile implementation, we are establishing a modern organizational structure that

can support modern software development, embrace the need to change and focus on warfighter value.

Our ALIS transformation leverages industry Information Technology experts, academia, and commercial best practices. Key to our success in the future will be our ability to scale product teams, aggressively eliminate manual maintenance and operational processes to drive down complexity and cost, and tackle common 80% requirements while designing for edge cases. One of the biggest cost drivers for the current ALIS system is the administrative cost. Current Operations and Sustainment (O&S) costs for ALIS, over its lifecycle, are estimated at \$29.5 billion. Today, combat coded squadrons require 12 system administrators to maintain deployed operations, in addition to home station operations. Training squadrons require eight system administrators in order to support a two-shift operation. As we transform ALIS into a 21st Century maintenance system, we are specifically targeting reductions in the number of administrators required to support ALIS operations in the field. Upcoming software releases include the capability for centralized administration, bulk administration of Portable Maintenance Aids, and squadron resource sharing. These initiatives will reduce the requirements for on-site administration of the current ALIS system with an estimated decrease in life cycles costs of \$1.9 billion, nearly a 6.5% cost reduction. As the team builds the future ALIS system, a primary focus is to reduce administration costs even further.

Enhance RMIP: The F-35 Reliability and Maintainability Improvement Program (RMIP) identifies and implements projects for design change, retrofit/modification, and process improvements to increase reliability and maintainability (R&M) of all aspects of the F-35 Enterprise. Projects include component redesigns, qualification of consumables for F-35 integration, repair procedure creation and qualification, as well as improvements to off-aircraft

systems such as support and pilot flight equipment. Taking both cost and performance into account, RMIP prioritizes projects based on return on investment. RMIP has integrated with our Affordability War Room and Cost Teams to ensure that Life Cycle Cost improvements are accurately applied to the Annual Cost Estimate.

The F-35 RMIP will continue through the lifecycle of the F-35, continually identifying R&M improvements across the F-35 Enterprise. As of October 2019, accelerating Reliability and Maintainability (R&M) improvement efforts increased F-35 Mission Capability (MC) rates by a validated 2.7% with a projected MC rate increase of greater than 7.4% based on in-work and identified projects. To date 161 projects have been identified, with 68 completed. In total, these projects have a projected life cycle cost avoidance of \$10.6 Billion.

Accelerate Software Modernization: Traditional waterfall software development approaches cannot deliver warfighting capabilities at the rate or affordability required to lead turn emerging threats in a growing battlespace. The F-35 Joint Program Office and Lockheed Martin are progressing together toward a software modernization goal of merging F-35 software development and sustainment efforts using agile methodologies to shorten the software development cycle and rapidly deliver high-quality code that drives these capabilities.

Today, our Block 4 software capabilities are being designed, coded, and tested in a collaborative agile environment. Software developers, testers, and users utilize tailored toolsets and automation where able to accelerate the corrective feedback loop resulting in more refined software sooner. The goal is to rapidly send software capabilities to formal lab or aircraft verification testing with maximum probability of first pass success. As we continue to refine our agile development process, we are also pursuing the expansion of network and cloud access to F-35 software development and testing toolsets to leverage the capacity and expertise of

government, industry, and Partner entities as a software development force multiplier.

III Ensuring progress to plan

While much work remains ahead, the program is already demonstrating a downward glide slope to achieving O&S cost. I am personally committed to ensuring we have speed factored into our plans for meeting the aircraft's affordability and availability targets. We have a number of efforts in progress to ensure rapid, tangible cost reductions in FY20. Our "180-Day Sprint" initiative captures all of these fast-paced efforts that drive a near-term focus and rapid progress on actions that will "move the needle" from an Air System perspective and give our warfighting customers confidence that we are making real progress. The 180-Day Sprint provides the administrative structure to employ agile planning tactics, which included a joint effort between Industry and the U.S. Services to develop and deliver an affordable sustainment Life Cycle Sustainment Plan of Action and Milestones; an engagement plan to solicit improvement ideas; an agile Sustainment Improvement Program to enable rapid and consistent evaluation of and investment in Cost Reduction Initiatives, Reliability and Maintainability Improvement Program initiatives, Maintenance Planning improvements, Prognostic Health Management updates, and quick investments in Science and Technology where they make sense – all of which will enable us to provide the Services' desired cost reductions and performance improvements on the most aggressive timelines possible.

A key component to our enduring progress is our continued dialogue with the General Accounting Office (GAO) and our ability to fully address those concerns highlighted by their recent reporting. The F-35 program has made significant progress on a number of challenges outlined by the GAO to include supply chain management, improvements to reliability and preparation for future modernization efforts.

We have concurred with the vast majority of the GAO's recent recommendations and are striving to implement solutions and mitigations in each of the areas discussed in their 2019 reports. Specifically, I would point to our progress in working with our Industry Partner to address the difficult challenge associated with acquiring necessary F-35 provisioning and cataloging data that will assist us in the development of a DOD-led supply chain management capability for the F-35. We now have a contract in place that will require Lockheed Martin to build and deliver a Data Management Plan addressing selecting criteria for F-35 system and sub-systems and technical data deliveries, a supporting Integrated Master Schedule, and a Rough Order of Magnitude (ROM) cost estimate for the delivery of data associated with these systems and sub-systems. This will be a heavy lift, and our government teams will need to work closely with Lockheed Martin so that we fully understand the complexities and any risks involved in working through these technical data deliveries and their impacts to our future supply chain improvements – but we have now started that process. I thank our GAO leadership and teams for working with us to “dig-in” to the program's challenges, including supply chain management, and I look forward to a continued dialogue as we head into 2020.

IV Conclusion

The F-35 Enterprise is making great strides across our three lines of effort. In development, the C2D2 process is maturing and has begun delivering highly relevant increments of capability over time. Production continues to ramp as demonstrated with the recent Lot 12-14 contract award and we will continue to demand the highest quality from our industry partners and to aggressively drive cost out of the production line, just as we've demonstrated in this latest award. I can assure you that I am committed to following through on our commitments to improve Mission Capable Rates, particularly among our forward deployed squadrons, and

driving down operating costs for the global fleet. Throughout, I will ensure my teams continue to execute with diligence, discipline, and dedication. We serve with the single-minded determination that the U.S. and its allies will never fight a fair fight, that our warfighters will return home safely from every engagement, and that our taxpayers get the absolute best capability for their defense dollar.

Lieutenant General Eric T. Fick
Program Executive Officer for the F-35 Lightning II Joint Program

Lt. Gen. Eric T. Fick is the Program Executive Officer for the F-35 Lightning II Joint Program Office in Arlington, Virginia. The F-35 Lightning II Joint Program Office is the Department of Defense's agency responsible for developing, delivering and sustaining the F-35A/B/C, the next-generation strike aircraft weapon system for the Air Force, Navy, Marine Corps, eight international partners and four current foreign military sales customers.

Lt. Gen. Fick entered the Air Force in September of 1990 after graduating from the University of Notre Dame with a Bachelor's degree in Aerospace Engineering. He has served as a Logistics Plans and Programs Officer, F-16 Fighting Falcon Mechanical Systems Engineer, Computational Fluid Dynamics Research Engineer, Joint System Program Office Chief of Test, Air Staff Branch Chief, Deputy Chief of the Air Force Senate Liaison Office and Director of Global Reach Programs, Office of the Assistant Secretary of the Air Force for Acquisition. Lt. Gen. Fick has commanded at the squadron and group level and served twice as an Air Force Program Executive Officer. Additionally, he has logged more than 350 hours in the T-38 Talon, F-15 Eagle, F-16 and other military and civilian experimental aircraft.

Prior to his current assignment, Lt. Gen. Fick was the Deputy Program Executive Officer for the F-35 Lightning II Joint Program.

EDUCATION

1990 Bachelor of Science, Aerospace Engineering, University of Notre Dame, South Bend, Ind.
 1995 Master of Science, Aeronautical Engineering, Air Force Institute of Technology, Wright-Patterson Air Force Base, Ohio (Distinguished Graduate)
 1996 Squadron Officer School, Maxwell AFB, Ala.
 1998 Experimental Flight Test Engineer Course, Air Force Test Pilot School, Edwards AFB, Calif. (Distinguished Graduate)
 2003 Master of Military Operational Art & Science, Air Command and Staff College, Maxwell AFB, Ala. (Distinguished Graduate)
 2006 Air War College, Maxwell AFB, Ala., by correspondence
 2007 Program Management Office Course, PMT-352B, Eglin AFB, Fla.
 2009 Master of Science, National Resource Strategy, Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C. (Distinguished Graduate; Honor Graduate)
 2009 Senior Acquisition Course, Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C.
 2010 Air Force Enterprise Leadership Seminar, University of Virginia, Darden School of Business, Charlottesville
 2011 Program Manager's Course, PMT-401, Fort Belvoir, Va.
 2012 Executive Program Manager's Course, PMT-402, Fort Belvoir, Va.

ASSIGNMENTS

September 1990 - March 1992, Logistics Plans and Programs Officer, Hill Air Force Base, Utah
 March 1992 - March 1994, F-16 Mechanical Systems Engineer, Hill AFB, Utah
 March 1994 - December 1995, Student, Air Force Institute of Technology, Wright-Patterson AFB, Ohio
 December 1995 - December 1996, Computational Fluid Dynamics Engineer, Wright-Patterson AFB, Ohio
 December 1996 - December 1997, Flight Test Program Manager, Wright-Patterson AFB, Ohio
 December 1997 - December 1998, Student, U.S. Air Force Test Pilot School, Edwards AFB, Calif.
 December 1998 - July 2000, Deputy Chief, Weapons Test Flight, Eglin AFB, Fla.
 July 2000 - July 2002, Chief of Test, Counter-Air Joint System Program Office, Eglin AFB, Fla.
 August 2002 - June 2003, Student, Air Command and Staff College, Maxwell AFB, Ala.
 July 2003 - September 2003, Director, Direct Attack, Air Force Program Executive Office (Weapons),

Assistant Secretary of the Air Force (Acquisition), Headquarters U.S. Air Force, the Pentagon, Arlington, Va.

September 2003 - May 2004, Chief, Air Dominance Branch, Global Power Directorate, Assistant Secretary of the Air Force (Acquisition), Headquarters U.S. Air Force, the Pentagon, Arlington, Va.

May 2004 - July 2005, Deputy Chief, Air Force Senate Liaison Office, Assistant Secretary of the Air Force (Legislative Liaison), Headquarters U.S. Air Force, the Pentagon, Arlington, Va.

August 2005 - June 2006, Operations Officer, 46th Test Squadron, Eglin AFB, Fla.

July 2006 - July 2008, Commander, 46th Test Squadron, Eglin AFB, Fla.

August 2008 - June 2009, Student, Industrial College of the Armed Forces, Fort McNair, Washington, D.C.

July 2009 - August 2011, Commander, Advanced Combat Systems Group, Air Force Rapid Capabilities Office, Headquarters U.S. Air Force, the Pentagon, Arlington, Va.

September 2011 - July 2014, Program Executive Officer for Intelligence, Surveillance, Reconnaissance, and Special Operations Forces, Wright-Patterson AFB, Ohio

July 2014 - April 2016, Program Executive Officer for Fighters and Bombers, Wright-Patterson AFB, Ohio

April 2016 - May 2017, Director, Global Reach Programs, Assistant Secretary (Acquisition), the Pentagon, Arlington, Va.

May 2017 - present, Deputy Program Executive Officer, F-35 Lightning II Joint Program Office, Arlington, Va.

SUMMARY OF JOINT ASSIGNMENTS

1. May 2017 - present, Deputy Program Executive Officer, F-35 Lightning II Joint Program Office, Arlington, Va. as a brigadier and major general

FLIGHT INFORMATION

Rating: none

Flight hours: more than 350

Aircraft flown: T-38, F-15B, F-15E, F-16, F-18, Learjet-24, E-3A, KC-135R, T-39E, C-17A, C-141C, MiG-15, T-43A, Challenger 604, C-12C, MC-130E, Bell 206, NC-130H, NU-1B, TH-6B, T-6G, Cessna Citation, CM-170, MB-326, L-039C, ASK-21, L-23, Grob-103, Schweizer 2-33

MAJOR AWARDS AND DECORATIONS

Distinguished Service Medal

Defense Superior Service Medal

Legion of Merit

Defense Meritorious Service Medal

Meritorious Service Medal with oak leaf cluster

Aerial Achievement Medal with oak leaf cluster

Joint Service Commendation Medal

Air Force Commendation Medal with oak leaf cluster

Air Force Achievement Medal

Military Outstanding Volunteer Service Medal

EFFECTIVE DATES OF PROMOTION

Second Lieutenant July 23, 1990

First Lieutenant July 23, 1992

Captain July 23, 1994

Major Sept. 1, 2001

Lieutenant Colonel May 1, 2005

Colonel Oct. 1, 2008

Brigadier General Oct. 3, 2014

Major General Aug. 3, 2018

Lieutenant General July 11, 2019

(Current as of August 2019)

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UNTIL APPROVED BY THE
COMMITTEE ON ARMED SERVICES
U.S. HOUSE OF REPRESENTATIVES**

STATEMENT

BY

ROBERT F. BEHLER

DIRECTOR, OPERATIONAL TEST AND EVALUATION

OFFICE OF THE SECRETARY OF DEFENSE

BEFORE THE

HOUSE ARMED SERVICES COMMITTEE

TACTICAL AIR AND LAND FORCES AND READINESS SUBCOMMITTEES

ON

CURRENT STATE OF F-35 INITIAL OPERATIONAL TEST AND EVALUATION

**NOT FOR PUBLIC RELEASE
UNTIL APPROVED BY THE
COMMITTEE ON ARMED SERVICES
U.S. HOUSE OF REPRESENTATIVES
HASC – NOVEMBER 13, 2019**

Robert F. Behler
Director, Operational Test and Evaluation (DOT&E)
Office of the Secretary of Defense

Chairman Norcross, Chairman Garamendi, Ranking Member Hartzler, Ranking Member Lamborn and distinguished members of the committees, I appreciate the opportunity to provide the current state of F-35 Initial Operational Test and Evaluation (IOT&E) and to address F-35 readiness for combat.

In my written testimony, I will discuss four main topics:

- 1) Progress in the ongoing F-35 IOT&E, which will support a full-rate production decision.
- 2) A summary of the remaining test events and the path to completing IOT&E.
- 3) A summary of the requirements and readiness of the F-35 Joint Simulation Environment (JSE).
- 4) F-35 sustainment observations from an operational test perspective.

Status of IOT&E

The JSF Operational Test Team (JOTT) has been making positive progress on safely and effectively executing the IOT&E test plan. DOT&E has been collaborating closely with the JOTT, the F-35 Joint Program Office (JPO) and Service operational test agencies to ensure test adequacy to evaluate the F-35's lethality, survivability and readiness. Testing to date has included open-air test missions, actual weapons employment, cybersecurity, deployments, and comparison testing with fourth generation fighters against traditional and more contemporary fielded threats.

In order to complete IOT&E as efficiently as possible and provide timely feedback to the warfighter, I approved early increments of the IOT&E test plan that were ready for execution, up

to 11 months prior to the formal start of IOT&E. The first increment began in January 2018 with a JOTT deployment to Alaska for cold-weather testing. In April 2018, I approved a second increment that included missions in permissive threat environments, weapons, cybersecurity, and deployments to ships and austere operating locations. These test missions were primarily two-ship formation scenarios, designed to evaluate the F-35 in the roles of Close Air Support, Forward Air Controller (Airborne), Strike Coordination and Reconnaissance, Combat Search and Rescue, and Aerial Reconnaissance. Additionally, numerous air-to-air missile shots and air-to-ground munitions events were completed in operationally realistic scenarios. The JOTT also conducted deployments to the USS *Abraham Lincoln* with the F-35C; to Volk Field, Wisconsin with the F-35A; and to Marine Corps Air Station Yuma, Arizona with the F-35B. As prescribed in the FY17 National Defense Authorization Act, the test teams also completed the F-35A and A-10C comparative test missions in late March 2019. Since 2016, preceding the start of IOT&E, test teams have completed multiple rounds of periodic operational cybersecurity testing of the Autonomic Logistics Information System (ALIS), training systems, and the U.S. Reprogramming Laboratory for mission data at Eglin AFB, Florida, as well as component-level cybersecurity testing of the air vehicle.

In coordination with the Office of the Under Secretary of Defense for Acquisition and Sustainment and the F-35 JPO, I approved the start of formal IOT&E in December 2018 after the applicable remaining entrance criteria were met. The JOTT then began testing the F-35 in demanding open-air test missions designed to evaluate the roles of Offensive and Defensive Counter Air, including Cruise Missile Defense, Suppression/Destruction of Enemy Air Defenses, and Air-to-Surface Attack in higher-threat environments. The two final phases of formal IOT&E, which I will approve when the associated test infrastructure requirements are met, are

electronic warfare testing against robust surface-to-air threats at Point Mugu Sea Range (PMSR), California, and testing against dense, modern, surface and air threats in the JSE at Naval Air Station Patuxent River, Maryland.

As of today, the JOTT has completed 91 percent of the open-air test missions and weapons events, along with the majority of the suitability and cybersecurity events. The JOTT finished most of the open-air testing in September, including all planned missions at the Nevada Test and Training Range (NTTR). To conserve resources and save time, I also approved several reductions to planned testing based on having already collected enough data or obvious outcomes that did not require further testing. For example, I reduced planned F-16/F-18 comparison testing from 18 test missions to two missions, which saved roughly 192 sorties and \$19 million in test range and operations costs. I also deleted 13 other planned test missions because we had already collected sufficient data, saving approximately \$9 million.

Remaining IOT&E Events

The remaining formal IOT&E test events include test missions off the West Coast, at PMSR, missile and bomb events, cybersecurity test events, and testing in the JSE. The JSE test missions will be used to supplement the open-air test data against near-peer threats in higher densities. Missions in the JSE include Offensive and Defensive Counter Air, such as Cruise Missile Defense, Suppression/Destruction of Enemy Air Defenses, and Air-to-Surface Attack.

Preparations for test missions at PMSR are ongoing. In coordination with NTTR, range management at PMSR began accepting additional Radar Signal Emulator (RSE) threat systems from NTTR in October 2019. The RSEs are used to represent contemporary fielded threats that add realism to the open-air test missions. By early calendar year 2020, 13 RSEs will be in place and are expected to be ready to support the electronic warfare missions at PMSR in March.

Joint Simulation Environment (JSE) Requirement and Status

The F-35 JSE at NAS Patuxent River, Maryland, is a man-in-the-loop synthetic environment that utilizes the actual aircraft software. It is designed to provide a scalable, high-fidelity simulation that replicates realistic combat environments. JSE will be the only venue available, other than actual combat against peer adversaries, to adequately evaluate the F-35 because of the inherent limitations associated with open air testing. These limitations do not permit a full and adequate test of the aircraft against the required types and densities of modern threat systems (weapons, aircraft, electronic warfare) currently fielded by near-peer adversaries. Additionally, the JSE is a critical element in developing and testing the next-generation Block 4 capabilities for the F-35. Integrating the F-35 into the JSE is a very complex challenge but is essential to completing IOT&E, which will lead to the final IOT&E report.

A high-fidelity modeling and simulation environment is a long-standing requirement for adequate F-35 testing. The JSF Operational Requirements Document (ORD), Change 3, dated 19 August 2008, captured the full combat capability and threat environment requirements through the System Development and Demonstration phase of the program. The ORD also lists threat requirements at Initial Operating Capability (IOC) and IOC+10. The majority of these ORD-required threats are not available in open-air test.

The requirement for an IOT&E simulation environment was further documented when the Department re-baselined the program following the 2010 Nunn-McCurdy breach. This resulted in an Acquisition Decision Memorandum, dated 2 June 2010, that directed the program to develop a simulation environment on a schedule consistent with plans for conducting IOT&E. In 2015, the F-35 JPO and USD(AT&L) decided to move the F-35 simulation from a contractor venue to the JSE, which is a government-owned system. The initial schedule indicated that the

JSE would be operational by the end of FY17 to support IOT&E spin-up and testing. The current schedule indicates that the JSE will be ready to start the final phase of operational testing in the last quarter of FY20.

F-35 Readiness for Combat

The operational suitability of the F-35 fleet remains at a level below Service expectations. However, after several years of remaining relatively stable, several key suitability metrics are showing signs of slow improvement in CY19.

The fleet-wide monthly availability rate for U.S. aircraft, for the 12 months ending September 2019, was below the target of 65 percent. However, the DOT&E assessment of the trend shows evidence of slight overall improvement in U.S. fleet-wide availability during 2019. In particular, while the average monthly availability for the 12 months ending September 2019 was only a few percent higher than the average monthly availability for the 12 months ending September 2018, the F-35 fleet's monthly availability generally slowly increased in 2019, and recently achieved historic program highs that approached the target availability rate.

No portion of the fleet, including the combat-coded fleet, was able to achieve and sustain the 80 percent Mission Capable rate goal set by then Secretary of Defense Mattis. However, individual units were able to achieve the 80 percent target for short periods during deployed operations. Similar to the trend in aircraft availability, the Mission Capable and Full Mission Capable rates of the whole U.S. fleet improved slightly in 2019. Full Mission Capable rates lagged the overall Mission Capable rates by a large margin, indicating low readiness for operational missions that require fully capable aircraft. All three variants achieved roughly similar Mission Capable rates, but significantly different Full Mission Capable rates. The F-35A displayed the best Full Mission Capable performance, while the F-35C fleet had the lowest Full

Mission Capable rate; the F-35B's Full Mission Capable rate was roughly midway between the other two variants. The recent improvement in availability and MC rates was supported largely by greater availability of spare parts (through the program's initiative to buy more spares) and longer-term efforts to improve maintenance processes and depot support.

None of the F-35 variants is meeting either the reliability or the maintainability metrics that are specified in the ORD. For reliability, the specific metrics are Mean Flight Hours Between Critical Failure (MFHBCF), Mean Flight Hours Between Removal (MFHBR), and Mean Flight Hours Between Maintenance Event Unscheduled (MFHBME_Unsch). For maintainability, the metrics are Mean Corrective Maintenance Time for Critical Failures (MCMTCF) and Mean Time To Repair (MTTR).

Although the F-35A accumulated the flight hours designated for maturity in July 2018, to date it has not been able to meet any of the ORD's full reliability or maintainability requirements for mature aircraft. The F-35B and F-35C have not yet reached their flight hours designated for maturity and thus were assessed against interim goals. The results show that neither the F-35B nor F-35C currently is on track to meet ORD reliability or maintainability requirements when they attain flight-hour maturity. In short, for all variants, aircraft are breaking more often than planned and taking longer to fix.

My F-35 IOT&E report will provide final results and analysis after completion of the IOT&E. Due to operational security concerns, the majority of the report will be classified appropriately. For these reasons, I cannot discuss specific IOT&E results in this public hearing; however, I would be happy to provide preliminary observations in the appropriate venue.

As always, my staff and I stand ready to address any questions or concerns you may have. This concludes the prepared portion of my testimony and I look forward to answering the committee's questions. Thank you.

Robert F. Behler
Director of Operational Test and Evaluation

Robert F. Behler was sworn in as Director of Operational Test and Evaluation on December 11, 2017. A Presidential appointee confirmed by the United States Senate, he serves as the senior advisor to the Secretary of Defense on operational and live fire test and evaluation of Department of Defense weapon systems.

Prior to his appointment, he was the Chief Operating Officer and Deputy Director of the Carnegie Mellon University Software Engineering Institute (SEI), a Federally Funded Research and Development Center. SEI is a global leader in advancing software development and cybersecurity to solve the nation's toughest problems through focused research, development, and transition to the broader software engineering community.

Before joining the SEI, Mr. Behler was the President and CEO of SRC, Inc. (formerly the Syracuse Research Corporation). SRC is a not-for-profit research and development corporation with a for-profit manufacturing subsidiary that focuses on radar, electronic warfare and cybersecurity technologies. Prior to working at SRC, Mr. Behler was the General Manager and Senior Vice President of the MITRE Corp where he provided leadership to more than 2,500 technical staff in 65 worldwide locations. He joined MITRE from the Johns Hopkins University Applied Physics Laboratory where he was a General Manager for more than 350 scientists and engineers as they made significant contributions to critical Department of Defense (DOD) precision engagement challenges.

General Behler served 31 years in the United States Air Force, retiring as a Major General in 2003. During his military career, he was the Principal Adviser for Command and Control, Intelligence, Surveillance and Reconnaissance (C2ISR) to the Secretary and Chief of Staff of the U.S. Air Force (USAF). International assignments as a general officer included the Deputy Commander for NATO's Joint Headquarters North in Stavanger, Norway. He was the Director of the Senate Liaison Office for the USAF during the 104th congress. Mr. Behler also served as the assistant for strategic systems to the Director of Operational Test and Evaluation. As an experimental test pilot, he flew more than 65 aircraft types. Operationally he flew worldwide reconnaissance missions in the fastest aircraft in the world, the SR-71 Blackbird.

Mr. Behler is a Fellow of the Society of Experimental Test Pilots and an Associate Fellow of the American Institute of Aeronautics and Astronautics.

He is a graduate of the University of Oklahoma where he received a B.S. and M.S. in aerospace engineering, has a MBA from Marymount University and was a National Security Fellow at the JFK School of Government at Harvard University.

Mr. Behler has recently been on several National Research Council studies for the National Academy of Sciences including: "Critical Code," "Software Producibility, Achieving Effective Acquisition of Information Technology in the Department of Defense" and "Development Planning: A Strategic Approach to Future Air Force Capabilities."

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SUBCOMMITTEES ON
READINESS AND TACTICAL AIR & LAND FORCES

STATEMENT OF
GREGORY ULMER
VICE PRESIDENT AND GENERAL MANAGER
F-35 PROGRAM
LOCKHEED MARTIN CORPORATION

BEFORE THE
READINESS AND TACTICAL AIR & LAND FORCES SUBCOMMITTEES
HOUSE ARMED SERVICES COMMITTEE
ON
F-35 PROGRAM UPDATE: SUSTAINMENT, PRODUCTION AND
AFFORDABILITY CHALLENGES

NOVEMBER 13, 2019

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READINESS AND TACTICAL AIR & LAND FORCES

I. INTRODUCTION

Delivering on the F-35 Value Proposition

On behalf of Lockheed Martin and the 220,000 men and women of the F-35 Industrial Team, thank you for the opportunity to speak with you today for the steadfast support of the F-35 program. To support today's hearing this testimony includes an update on the F-35 program, as well as additional information on our progress in production, sustainment, and modernization of the F-35.

When the Joint Strike Fighter program was initially envisioned in the 1990s, the value proposition centered on four main tenets: 1) design a multi-role fighter capable of replacing several legacy aircraft across the U.S. Services and our allies; 2) leverage collective investment from the U.S. and original partner nations to develop the most advanced technology; 3) deliver affordability through economies of scale; and 4) provide unmatched interoperability for increasing coalition operations.

Today, I am proud to report that the F-35 is delivering on all four tenets of this value proposition.

The F-35's stealth technology, supersonic speed, advanced sensors, weapons capacity and increased range make it the most lethal, survivable and connected aircraft operating in the world today. More than 455 F-35s are operating globally, serving as a powerful force multiplier – enhancing all airborne-, sea-, and ground-based assets in the battlespace. Wherever it operates, the F-35 has proved that it is a powerful force supporting the mission and protecting the lives of the U.S. Armed Forces as well as those of our allies.

All three U.S. Services – the Air Force, Navy and Marine Corps – and five international customers have declared initial operating capability (IOC) for their F-35 programs. This is a public declaration that their aircraft are mission ready and combat capable. In addition, the Israeli Air Force, the U.S. Marine Corps, the U.S. Air Force and the United Kingdom's Royal Air Force – have flown their F-35s in combat. The feedback from all of them is that the aircraft is a game-changing asset that performs exceptionally well.

The F-35 program will garner more successes in the years ahead, as it continues to expand. With the recent arrival of Royal Netherlands Air Force jets to Leeuwarden Air Base, F-35s now operate from 20 bases, and three ships, with nine countries in the program operating aircraft on their home soil. The global F-35 fleet recently surpassed 230,000 flight hours. And, in the U.S., the first F-35s were recently delivered to Burlington Air National Guard Base, ushering in a new era of capability and readiness for the Air National Guard.

The F-35 program has become a global example of cooperation and coordination. Although program management is highly complex, the Joint Program Office (JPO), U.S. Services, the international services, and industry have worked together to deliver a 5th Generation aircraft that far exceeds the capabilities of legacy platforms. Following completion of the safest and most comprehensive flight test program in aviation history, this partnership is now focused on maximizing the F-35 partners' continued investment to bring new capabilities that will increase the aircraft's impact and lethality.

And we're aligning these improvements across each aspect of the fully integrated Air System, which includes the air vehicle, full mission simulators, the Autonomic Logistics Information

System (ALIS), training systems, operational flight program (OFP), mission data files and other deliverables.

Today we're developing, leveraging and integrating new technology to ensure the F-35 stays ahead of ever-evolving threats, while widening the gap over 4th Generation aircraft. F-35 modernization comprises both software upgrades as well as hardware technology refreshes, which are funded and prioritized by the F-35 JPO, in agreement with the F-35's Joint Executive Steering Board which includes representatives from all partner nations.

As we continue to increase the F-35's capabilities, we're also reducing costs. On October 29, 2019, we announced the contract agreement for Lots 12 to 14, which supports 478 aircraft for the U.S., international partners and foreign military sales customers. In the agreement, the enterprise has met and accelerated its long-standing F-35 procurement cost-reduction goals, with the F-35A price dropping below \$80 million in both Lots 13 and 14, representing a more than 70 percent reduction since the first production contract. The sub \$80 million unit recurring flyaway cost, to include airframe and propulsion system, for an F-35 represents a significant milestone where we are now delivering 5th Generation capability below 4th Generation cost. With embedded integrated sensors and targeting pods, this F-35 unit price includes items that add additional procurement and sustainment costs to legacy 4th Generation aircraft.

The agreement also significantly reduces the costs of the F-35B and F-35C models, providing an average savings of 12.7 percent across all three variants from Lot 11 to Lot 14. Although the U.S. Services procurement profile has declined from original projections, we were able to deliver these costs savings through smart acquisition strategies, improving efficiencies and increasing automation.

As the F-35's affordability increases, we see rising global demand from both our existing customers as well as new potential foreign military sales opportunities and the program of record for the F-35 has grown from roughly 3,000 aircraft to nearly 3,500. Three of our international customers – Japan, The Netherlands and the Republic of Korea – have all announced their intent to expand their programs of record. We see strong interest from Poland on an accelerated purchase of 32 F-35A aircraft, with the potential for 32 additional aircraft, and the F-35 continues to be in active competitions in Canada, Finland and Switzerland.

The F-35 is quickly becoming a key discriminator in coalition operations, with users benefitting from common training, equipment and tactics, and participation in joint combat training exercises. Earlier this year the Norwegian Air Force and its F-35s participated alongside the U.S. Air Force in the biennial Arctic Challenge exercise; Exercise Tri-Lightning demonstrated the interoperability between the U.S., U.K. and Israel using the F-35A, F-35B, and F-35I respectively in a defensive counterair exercise over the Eastern Mediterranean; and recently the Italian Air Force conducted a NATO air-policing mission in Iceland with their F-35 fleet, demonstrating an average mission capable rate of greater than 90 percent.

The unmatched interoperability of the F-35, positions the aircraft at the heart of multi-domain operations for U.S. and allied nations. The F-35's ability to collect, analyze and share data, is a powerful Intelligence, Surveillance, and Reconnaissance (ISR) asset and force multiplier that enhances all airborne, surface and ground-based assets in the battlespace and will ensure coalition operations operate at an advantage for decades to come.

Alignment to the National Defense Strategy

At Lockheed Martin we believe the F-35 is the National Defense Strategy in action, aligning to the pillars of building a more lethal force, strengthening alliances and attracting new partners, as well as delivering greater affordability. The NDS makes clear that the modern battlespace requires stealth, advanced sensing capability, coalition interoperability, cyber security and an ability to connect in a multi-domain fight. The F-35 delivers on all of these capabilities above and beyond any other aircraft in the U.S. inventory or anywhere else around the globe.

For instance, the F-35 provides the mission flexibility to operate in stealth mode with more than 5,000 pounds of internal weapons. And this capability will soon be expanded. It also has the ability to load more than 18,000 pounds of weapons externally and internally, increasing its lethality. The F-35 could be configured to carry hypersonic weapons on its external F-35 heavy stores stations. The F-35 can conduct ISR, electronic attack, and targeted strike missions as means to maintain cross-domain superiority across the spectrum of military operations and enhance lethality for the U.S. Services and our allies.

The F-35's training and operational success, growing program of record, and sustained global interest means it is strengthening U.S. alliances across the globe. As we look at current geopolitical challenges, the F-35 will play a key role in maintaining stability in the Indo-Pacific region, deterring aggression against the Trans-Atlantic NATO Alliance, and degrading the threat of terrorism in the Middle East and Africa.

The Department of Defense's adoption of innovative programs like Blueprint for Affordability and the recent Block Buy acquisition strategy provide for greater affordability on the F-35 program. We will continue to partner with the F-35 JPO to identify ways we can bring more commercial business models into the program to reduce costs, acquisition risks and technological obsolescence issues on the F-35 program.

Continued Focus on Affordability and Readiness

Across the F-35 enterprise we're focused on delivering affordability throughout the production, sustainment and modernization lines of effort. We believe that with applied engineering discipline, focused investments, and updated contracting structures, we will deliver similar cost reductions and efficiencies in sustainment and modernization to what we have achieved on the production side of the program.

As operational deployments continue to increase, we're keenly focused on the need to reduce sustainment costs and improve mission readiness. Recently, we have seen evidence of sustainment cost reductions and expect that trend to continue as operational lessons learned are implemented, data-informed predictive health monitoring improves, spare parts availability increases, and a more robust repair capacity is realized.

Although the F-35 has not been without its share of development and technical challenges, the program progress outlined above demonstrates it is currently on a positive glide path and is solidifying its role as the backbone of the U.S. and our allies' future fleets. Further, the delivery of each successive production lot has brought improved reliability, and performance is up across the F-35 fleet.

In addition, the F-35 is showing tremendous flexibility, as it is deployed on operational missions and conducting advanced training exercises. In fact, users are deploying the aircraft in ways that were not initially envisioned, demonstrating that the full potential of the 5th Generation weapon system remains unknown. The integration of such a technologically advanced asset is defining a new concept of operations for our customer and expanding the mission profile set of the F-35.

We recognize that the continued support of Congress, and the House Armed Services Committee, is fundamental to the success of this program. On behalf of the F-35 Industrial team I offer our thanks for your efforts to ensure the program remains funded and your commitment to ensuring the men and women of the U.S. military have the most advanced equipment available. Your support of the F-35 program and recognition of its importance in national security is a driving force for our success.

II. Production Update

The F-35 Lightning II was designed to be an affordable 5th Generation fighter, taking advantage of economies of scale and commonalities between the three variants. Currently production spans three Final Assembly and Check Out Facilities – Fort Worth, Texas; Cameri, Italy; and Nagoya, Japan. F-35 production builds more aircraft per year than any other fighter line in the world and our goal for 2019 is to deliver 131 aircraft, up 40 percent from last year's 91 aircraft deliveries.

We anticipate that the F-35 production will continue to increase in volume year over year to hit peak production of approximately 165 aircraft in 2023 to support the current program plan. With additional supply chain capacity, we could deliver up to 189 aircraft per year, accommodating increased ramp rates for the U.S. Services, which we believe is essential to achieve the full program of record and deliver the capability needed for the U.S. to maintain its competitive advantage on the global stage while also replacing aging fighter fleets at home and abroad.

As we ramp up production, we remain focused on lowering cost, reducing build times, and improving on-time delivery and quality by incorporating lessons learned, process efficiencies, supply chain initiatives, facility and tooling upgrades and more. We continue to invest in and align our manpower, machines, materials and methods to ensure we meet the growing demand while achieving our cost, quality and schedule goals.

We have made significant progress reducing touch labor, or hands-on production, reducing the hours by 75 percent since the first Low Rate Initial Production (LRIP) contract saving thousands of hours in the build time for each F-35, and our final assembly span times have been reduced over 35 percent since 2016. Beginning in Lot 11, there are Performance Incentive Fees in place to track and measure our span times in specific areas of F-35 production, most notably Final Assembly.

We're working to improve performance across the board, including: reduce the top causes of scrap, rework, and repair (SRR) - or work that needs to be redone during production; ensure 100 percent parts availability to the production line; and identify the activities that take the most hours to complete and improve work processes accordingly. We have seen an SRR reduction by nearly 80 percent since LRIP 1 to LRIP 11 deliveries and expect to drive that to a more than 90 percent reduction from LRIP 1 to Lot 14 aircraft deliveries.

While we have successfully met our annual delivery targets two years in a row, each aircraft has a contractual delivery date, and we are working to improve performance so that we consistently meet our contractual delivery dates. In 2018, we delivered about 60 percent on or ahead of schedule, and we're averaging 85 percent on time delivery for aircraft this year.

Aligning the F-35 Supply Chain

The F-35 is built by thousands of men and women in the U.S. and around the world. The F-35 program supports a broad industrial base of more than 1,400 suppliers in 45 states and Puerto Rico, contributing to more than 220,000 direct and indirect U.S. jobs and more than \$44.2 billion in total annual economic impact. The program also includes more than 100 international suppliers, creating or sustaining thousands of international jobs.

The program's global supply chain accounts for approximately 70 percent of the total costs of an F-35, and we're working to ensure that all suppliers understand their role in driving affordability throughout the program and producing quality, on-time materials at the rate required for full rate production (FRP) and the increasing operational tempo. We are looking at every link in the global supply chain to find opportunities to increase capacity, reduce production and O&S costs, improve parts reliability, and enhance capabilities.

The F-35 supply chain is based on best value for the program and Lockheed Martin is recompeting several major components of the aircraft to ensure we have the latest technology, at the best price and increased reliability for our customers. An example of this is the selection of Raytheon to provide the Next Generation Distributed Aperture System (DAS), which will be integrated into the aircraft in Lot 15 (delivery year 2023). Next Gen DAS is expected to generate more than \$3 billion in life cycle cost savings, approximately 45 percent reduction in unit recurring cost, and greater than 50 percent reduction in operations and sustainment costs, while providing five times more reliability and two times performance capability improvement.

In addition to recompeting components, we are transitioning several F-35 suppliers to longer term Performance Based Logistics (PBL) contracts to enhance parts availability and reduce sustainment costs. Previously under annual contracts, the new 5-year PBLs allow each supplier to make longer term investments and actions to reduce costs and improve efficiencies.

We have also worked with our suppliers to enhance performance and reduce costs. With Blueprint for Affordability (BFA) initiatives, supplier mentor-protégé programs, proactively sharing best practices across the supply chain and more, our supply chain is performing and prepared to ramp to FRP.

Lockheed Martin also pre-funded approximately \$1 billion upfront to acquire select materials in bulk in support of Lots 12-14. This upfront commitment provided stability to the industrial base and enabled our suppliers to buy parts on time and reduce costs through economies of scale.

III. Sustainment Update

With production costs decreasing and quality improving, the F-35 enterprise has set some clear goals for reducing sustainment costs and increasing mission readiness. We're committed to delivering DOD's goals of \$25K cost per flight hour by 2025 and 80 percent mission capable rates. To achieve those goals, we're supporting the 5th Generation F-35 with 5th Generation Sustainment, characterized by holistic fleet-level management, predictive health analytics, condition-based maintenance and a focus on the flight line.

Readiness rates continue to rise across the fleet, and today we see on average a mission capable rate of more than 70 percent on combat-coded aircraft. Earlier this year, the U.S. Air Force announced that its airmen and fleet of F-35As participating at Red Flag at Nellis Air Force Base delivered 90 percent mission capable rates during the exercise. The U.S. Marine Corps achieved greater than 75 percent readiness rates with their F-35Bs during the first combat deployment – and the newest F-35Bs in Lot 10 and 11 are averaging greater than 80 percent mission capable rates. The Navy's F-35Cs are averaging 60 percent mission capable rates across the fleet.

A testament to the F-35's increased availability is this summer's multiple deployment activities by the 388th Fighter Wing from Hill Air Force Base. The Wing conducted operations from nine different countries on three separate continents involving nearly 70 F-35A aircraft, including a European Theater Support Package.

The increased cadence of F-35 operational and training missions is providing robust data and analysis shows the aircraft is exceeding reliability expectations, improving with each successive production lot. The data is also allowing us to improve our supply posture, align part stocking levels, improve depot capacity, reduce repair cycle times and speed up the logistics system to accelerate spares delivery for surge scenarios.

For example, recent U.S. Air Force deployments have shown that the original engineering predictions for deployable spares packages overpredicted the supply demand. We will partner with our customers to analyze the operational data and will decrease the requirements which will in turn reduce cost. Continually analyzing the data will ensure the Global Sustainment Solution has sufficient capacity and has the right parts in the right place at the right time to support combat surge rates.

To prepare for the quickly expanding global F-35 fleet, we're working to increase the funding of the Reliability and Maintainability Improvement Program to extend parts' time on wing and further reduce the demand on spare parts while simultaneously accelerating government depot standup and advancing PBL and Master Repair Agreements to increase repair capacity.

We have established solid partnerships with the military service depots and are working with depot leaders and the JPO to accelerate component repair activations. Some of the recent activations have been achieved more than one year ahead of schedule, and the remaining 42 workloads, or support for major components, are on track to be completed within the next four years. Once completed there will be 68 workloads activated at the Air Force and Navy depots, greatly improving the overall repair capacity.

Additionally, contracting timelines for spares have been significantly improved, so that the majority of the parts are available for fleet maintainers upon the aircraft delivery.

We're also seeing significant improvement on the service-driven aspects of sustainment costs, including an increasing velocity in maintenance throughput. As Airmen, Sailors and Marines become more experienced with servicing the F-35, their familiarity and proficiency will increase. This will enable reductions in manning for both contractor and military and an associated reduction in ownership costs.

ALIS Modernization

At Lockheed Martin, we want F-35 maintainers to feel the same pride and excitement as F-35 pilots, and we recognize that improving ALIS is foundational to changing their experience. In partnership with the JPO, our goal is to drastically improve speed, minimize hardware infrastructure, reduce required labor and enhance user experience and overall capability.

We continue to make incremental improvements with each ALIS software update. We recently fielded ALIS version 3.1.1. , which improves workflows and saves thousands of man-hours annually across the fleet. In flight test, users saved an average of about 35 minutes per flight in generation and pilot review; about 40 minutes per day in maintenance report generation and several hours per week in managing fleet directive reports. Extrapolated across the enterprise of more than 455 airplanes flying today, this saves more than 20,000 man-hours annually.

We are now fielding ALIS version 3.5 before year-end which will bring further improvements to the system, including improved Air Vehicle transfers, usage and aircraft component stabilization, Low Observable Health Assessment System (LOHAS) enhancements, Electronic Equipment Logbook (EEL) visibility with dashboard, and improved inventory accuracy.

The incremental enhancements to ALIS are directly improving performance on the production flight line. In August 2019, a newly delivered F-35A aircraft landed Code One and flew its first operational mission within five hours of landing at Hill AFB from Lockheed Martin's Fort Worth factory.

This latest release leverages Lockheed Martin's internal investment in 2018 of \$50 million, which will rise to approximately \$180 million through 2021 to modernize ALIS and enhance enterprise sustainment systems.

We are also partnering with the JPO and 309th Software Squadron from Hill AFB to make longer-term investments that take advantage of agile concepts and commercially available tools, and also account for unique warfighter operational needs like deploying to austere sites, supporting operations with no network connections, and upholding stringent security and cyber requirements. Lockheed Martin's goal is to deliver a modernized ALIS by 2020 that is driven by 4 key enhancements:

- **Agnostic cloud-native architecture:** As the ALIS integrator, Lockheed Martin is moving ALIS applications to a cloud-native, open architecture, we can rapidly develop and test pieces of ALIS for each upgrade. And instead of aggregating many fixes over a 12 to 18-month period into a single "big bang" upgrade, the new approach allows developers to create, test, receive feedback and implement incremental fixes every few weeks while reducing development and fielding costs. The important part of this modernized architecture is the cloud-enabled technology – which enables secure development operations (DevSecOps) and lower administration cost while allowing incorporation of 3rd party commercial off-the-shelf software modules, additional applications developed by others into ALIS.
- **Automated test and deployment:** The DevSecOps approach increases the ability to conduct automated test and deployment of software updates utilizing commercial best practices to improve velocity of updates and improvements to the field. A testament to

the DevSecOps approach was our recent ability to issue eight software upgrades in just one week.

Improved user interface and user experience: Lockheed Martin partnered with Silicon Valley company UE Group to redesign the ALIS weapons loading user interface, driving complexity, time and cost out of maintenance workflows in ALIS. The JPO team validated a 60 percent improvement in the workflow for weapons loading using the newly designed user interface. We have not stopped there however, as we continue to modernize and re-engineer older code and data structures into improved performing applications fielded in a rapid manner – in fact striving for the “pace of war.” Lockheed Martin has done this although each of our U.S. Services, international partners and foreign military sales countries have different operating concepts, missions, and sovereign needs.

- **Strengthened cyber security and data resiliency:** With the transition to a cloud-native architecture we continue to improve the cyber security of ALIS and we've implemented several actions including automation and enhanced supplier accountability processes that are delivering improved data resiliency. In addition, offline key data is vetted and validated automatically versus manually, improving speed and ensuring accurate integrated data. With these new actions and related efforts, we've seen a 50 percent reduction in Electronic Equipment Logbooks and other action requests since 2017, which indicates software and data quality are steadily improving.

F-35 Performance Based Logistics (PBL) Concept

To achieve the goals outlined in the DOD's Life Cycle Sustainment Plan (LCSP), Lockheed Martin is proposing to transition F-35 sustainment to a five-year fixed price PBL contract structure supported by \$1.5 billion company advanced funding, in addition to ongoing affordability projects being pre-funded by Lockheed Martin.

A five-year PBL, coupled with the advanced funding, will provide the stability and funds needed to accelerate costs savings and improve readiness rates for the F-35, while allowing the program to operate within its existing budget top line. The approach is estimated to net our customers' \$1 billion in savings over the five-year period from 2021-2025, with \$600 million going to the USG and \$400 million to the F-35 partner nations. It will also enable the fleet to achieve its key 2025 readiness and cost targets.

We have identified more than 200 Product and Performance Initiatives (PPI) that will be enabled by the PBL. These projects will allow us to drive savings by reducing materials costs, manpower and Mean Time to Repair (MTTR); increasing automation; improving tools and processes, inventory control, supply capacity and reliability; and enhancing repair capacity.

The vast majority of F-35 sustainment work today is implemented through single year, transactional contracts negotiated annually and requiring more than 100 Contract Line Item Numbers (CLINs) that are not outcome based. The new contracting structure would be based on a five-year Indefinite Delivery Indefinite Quantity (IDIQ) contract framework that is Firm Fixed Price, thus shifting risk to industry.

The current state provides no long-term stability, adds administrative costs and minimizes the potential for significant industry investments, improvements and outcome-focused efforts. It also

reduces transparency and visibility for each customer to see how their funding is directly impacting readiness.

Transitioning from the current annual, transactional contracting approach for F-35 Sustainment to a five-year PBL contract can reduce the annual negotiation burden, improve government-industry partnerships, stabilize the supply chain and enable industry investments to achieve target outcomes.

A joint industry and government Quick Look Team is assessing the value of the PBL to the F-35 enterprise and is exploring ways to best implement a PBL strategy that will optimize performance, improve readiness and maximize cost savings.

IV. Modernization Update

The F-35 is designed to incorporate both software and hardware upgrades throughout its 50+ year life cycle and efforts to modernize the aircraft are already underway. We'll deliver F-35 modernization through the Department's Continuous Capability, Development and Delivery (C2D2) framework for timely, affordable, incremental warfighting capability improvements. This approach will deliver more agile, continuous modernization on shorter timelines while aligning and synchronizing capability delivery across the entire F-35 Air System.

In order to maximize the investment in the F-35 fleet, it's imperative that Congress continues to fund the F-35 modernization plan to leverage the full potential of the weapon system. Additionally, it's important to note that many of the partner countries have made investments in modernization activities as part of their national defense policies and have established the industrial base to support these activities.

From Electronic Warfare, increased computing power, sensor capability, weapons capacity and more, we are actively enhancing all aspects of the F-35 to ensure it exceeds warfighter demands and outpaces evolving threats. Some key upgrades planned include:

- **Automatic Ground Collision Avoidance System (AutoGCAS):** AutoGCAS uses terrain mapping, geolocation and automation to detect and avoid potential ground collisions. When the program recognizes imminent impact, it will prompt the pilot to take action. If the pilot is unresponsive, AutoGCAS assumes temporary control to divert the aircraft out of harm's way, and then returns control of the aircraft to the pilot once on a safe trajectory. Leveraging a rapid, agile development, test and contracting approach, the joint government and industry team successfully fielded the life-saving technology seven years earlier than previously planned.
- **Technology Refresh 3 Upgrades:** Technology Refresh 3 takes advantage of fast evolving computing power and adds an Open Systems Architecture that will enable the flexibility for Lockheed Martin and our customers to add, upgrade and update future capabilities rapidly. In addition to the Next Generation Distributed Aperture System discussed previously, the F-35's Integrated Core Processor, Panoramic Cockpit Display and the Aircraft Memory System will all be upgraded beginning in Lot 15.
- **Multi-Domain Operations (MDO):** To increase the F-35's role in MDO, we're upgrading sensor fusion capability in Lot 13 and beyond, integrating enhanced voice and data interoperability in Lot 14 and continuing to conduct exercises to demonstrate MDO

teaming. To date, the F-35 has successfully integrated with the Aegis Missile Defense system, a High Mobility Artillery Rocket System, or HIMARS, the Integrated Air and Missile Defense Battle Command System (IBCS), and most recently in partnership with the Missile Defense Agency and U.S. Air Force, we successfully connected an F-35, U-2, and a multi-domain ground station. The advantages of the F-35 integrated and fused sensor suite now can be made available to other airborne, air, and even subsurface warfighters. We are active now in sharing the key benefits of our 5th Generation air system with other multi-domain parts of operations.

- **Unmanned Teaming:** The F-35 is ideally suited for manned / unmanned teaming operations, and we are working closely with our customers to realize a future where the F-35 can command and control unmanned aerial vehicles as wingmen as well as attritable assets in a joint fighting force. Through these and related efforts, this F-35 5th Generation weapon system serves as a force multiplier for our country and allies.
- **Missile Defense:** The F-35 offers inherent capabilities that can significantly enhance U.S. missile defense. The F-35's stealth and advanced sensor suite can help detect potential missile threats and provide 'Left of Launch' identification and engagement through entering contested airspace undetected. The F-35 can also serve as a sensor node to detect and track missile threats at a much closer distance – and connect sensor information to queue existing missile defense systems to engage an incoming threat. According to the Missile Defense Review, the Department of Defense is also building a technology roadmap to equip the F-35 with a new or modified interceptor capable of shooting down adversary ballistic missiles in their boost phase for direct engagement.
- **Extended Range:** While the F-35 as configured today, exceeds the specified range performance, we're engaged in an industry-funded study with Elbit Systems-Cyclone focused on a 600-gallon external tank and an associated jettison-able pylon for the F-35A to significantly increase range and loiter time.
- **Increased Lethality:** In addition to increasing the F-35A and F-35C's internal weapons capacity from four to six internal weapons, we're also working to integrate a series of new weapons to increase lethality. Additionally, the F-35 has the structural capacity on our inner wing stations to carry hypersonic weapons externally allowing the F-35 to execute deep strike missions while providing unmatched ISR capabilities. We also see a growth path in the future to add payload weight capacity and increase the total number of missiles the F-35 can carry.

As we integrate upgraded capabilities, our goal is to maintain or reduce both the unit cost to procure and the sustainment costs for F-35s across the enterprise.

V. Summary/Conclusion

At Lockheed Martin we understand the role the F-35 is playing in meeting the national security objectives of the U.S and our allies, enhancing interoperability and promoting regional stability. We are confident the F-35's transformational capability and growing role in multi-domain operations ensure it is an investment that strengthens our customers' entire Armed Forces. And we are committed to continually enhancing the F-35's advanced technology while driving

affordability through all aspects of the program to deliver the best value to the taxpayer and, most importantly, the warfighter.

On behalf of Lockheed Martin and the F-35 Industry Team, we're honored by our role in delivering this critical capability to our customers. Thank you for the opportunity to provide this program update. I look forward to your questions.

Gregory M. Ulmer
Vice President and General Manager F-35 Program
Lockheed Martin Aeronautics Company

Greg Ulmer is Vice President and General Manager, F-35 Lightning II Program, at Lockheed Martin Aeronautics Company. In this role, Mr. Ulmer leads all areas of the F-35 Lightning II fighter aircraft program, to include development, production, sustainment and modernization supporting three F-35 aircraft variants for three U.S. military services, eight international partner nations, and multiple foreign military sales customers.

Prior to this position, Mr. Ulmer was Vice President, F-35 Aircraft Production Business Unit for more than two years, responsible for all aspects of global F-35 production and delivery to include program management, production operations, supply chain management, quality, affordability, tooling and manufacturing rate readiness and customer engagement.

Mr. Ulmer formally held the position of Vice President of Operations for Advanced Development Programs (ADP), also known as the Skunk Works®, located at Lockheed Martin Aeronautics in Palmdale, California. In this role, he was responsible for the ADP operations comprised of more than 3,000 employees across multiple Aeronautics sites overseeing the F-22 Raptor Modification Line, U-2 Dragon Lady Periodic Depot Maintenance, F-35 Lightning II sub-assembly work and ADP Special Programs.

Previously, Mr. Ulmer was the C-5 Vice President and Program Manager responsible for the overall operations and leadership of the C-5 Reliability Enhancement and Re-Engining Program and the Avionics Modernization Program at Lockheed Martin Aeronautics in Marietta, Georgia. In this role, he also had overall leadership for C-5 legacy fleet sustainment, to include depot services, block upgrades, unscheduled depot level maintenance, and the Large Aircraft Infrared Countermeasures program.

Throughout his career, Mr. Ulmer has established a diverse aviation background in commercial aviation, tactical and strategic airlift, ISR and fighter aircraft. Earlier career leadership roles include service as the C-130 Deputy Program Manager for Operations; C-130 Air Vehicle Director; Deputy Chief Engineer and Flight Test Integrated Product Team (IPT) Senior Manager and more. Mr. Ulmer began his career as a flight test engineer supporting the MD-11, C-17, and C-130J programs from first flight through certification for all three air vehicles.

Mr. Ulmer graduated from California Polytechnic State University in San Luis Obispo, California, with a bachelor's degree in Aeronautical Engineering. He also holds an executive master's degree in Business Management with an emphasis on aerospace from the University of Tennessee.

Greg and his wife Shawnie reside in Fort Worth, Texas.

**DISCLOSURE FORM FOR WITNESSES
COMMITTEE ON ARMED SERVICES
U.S. HOUSE OF REPRESENTATIVES**

INSTRUCTION TO WITNESSES: Rule 11, clause 2(g)(5), of the Rules of the U.S. House of Representatives for the 116th Congress requires nongovernmental witnesses appearing before House committees to include in their written statements a curriculum vitae and a disclosure of the amount and source of any federal contracts or grants (including subcontracts and subgrants), or contracts or payments originating with a foreign government, received during the current and two previous calendar years either by the witness or by an entity represented by the witness and related to the subject matter of the hearing. As a matter of committee policy, the House Committee on Armed Services further requires nongovernmental witnesses to disclose whether they are a fiduciary (including, but not limited to, directors, officers, advisors, or resident agents) of any organization or entity that may have an interest in the subject matter of the hearing. Committee policy also requires nongovernmental witnesses to disclose the amount and source of any contracts or grants (including subcontracts and subgrants), or payments originating with any organization or entity, whether public or private, that has a material interest in the subject matter of the hearing, received during the current and two previous calendar years either by the witness or by an entity represented by the witness.

Please note that a copy of these statements, with appropriate redactions to protect the witness's personal privacy (including home address and phone number), will be made publicly available in electronic form not later than one day after the witness's appearance before the committee. Witnesses may list additional grants, contracts, or payments on additional sheets, if necessary. Please complete this form electronically.

Hearing Date: Wednesday, November 13, 2019

Hearing Subject:

F-35 Program Update: Sustainment, Production, and Affordability Challenges

Witness name: Gregory M. Ulmer

Position/Title: Vice President and General Manager, F-35 P

Capacity in which appearing: (check one)



Individual



Representative

If appearing in a representative capacity, name of the organization or entity represented:

Lockheed Martin Corporation

Federal Contract or Grant Information: If you or the entity you represent before the Committee on Armed Services has contracts (including subcontracts) or grants (including subgrants) with the federal government, received during the current and two previous calendar years and related to the subject matter of the hearing, please provide the following information:

2019

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant
N00019-17-C-0001	Naval Air Systems Command	\$ 13,073,251,811	BLOCK BUY - LOW RATE INITIAL PRODUCTION LOTS 12-14
N00019-19-C-0010	Naval Air Systems Command	\$ 1,967,414,165	F-35 FOM PHASE 2.3
N00019-19-C-1022	Naval Air Systems Command	\$ 1,159,041,472	FY19 ANNUALIZED
N00019-19-D-0015-N0001919F2699	Naval Air Systems Command	\$ 528,044,959	FY19 SPARES/ LOT 13 AME/PFE MATERIAL REQUIREMENTS
N00019-18-C-1048	Naval Air Systems Command	\$ 404,563,383	LOW RATE INITIAL PRODUCTION 11 NON-ANNUALIZED

2018

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant
N00019-17-C-0001	Naval Air Systems Command	\$ 20,900,049,669	BLOCK BUY - LOW RATE INITIAL PRODUCTION LOTS 12-14
N00019-18-C-1041	Naval Air Systems Command	\$ 1,455,312,603	FY 18 ANNUALIZED
N00019-14-G-0020-N0001919F0584	Naval Air Systems Command	\$ 1,066,212,000	FY 18 INITIAL SPARES
N00019-18-C-1048	Naval Air Systems Command	\$ 1,035,849,321	LOW RATE INITIAL PRODUCTION 11 NON-ANNUALIZED
N00019-14-G-0020-N0001919F2474	Naval Air Systems Command	\$ 809,110,778	TR3 PHASE 3

2017

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant
N00019-16-C-0033	Naval Air Systems Command	\$ 9,448,068,268	LOW RATE INITIAL PRODUCTION 11
N00019-17-C-0001	Naval Air Systems Command	\$ 1,490,198,520	BLOCK BUY - LOW RATE INITIAL PRODUCTION LOTS 12-14
N00019-17-C-0045	Naval Air Systems Command	\$ 1,321,965,640	FY17 ANNUALIZED SUSTAINMENT
N00019-15-C-0003	Naval Air Systems Command	\$ 966,951,249	LOW RATE INITIAL PRODUCTION 10
N00019-14-G-0020-0132	Naval Air Systems Command	\$ 890,360,759	FY 17 INITIAL SPARES

Foreign Government Contract or Payment Information: If you or the entity you represent before the Committee on Armed Services has contracts (including subcontracts or subgrants) or payments originating from a foreign government, received during the current and two previous calendar years and related to the subject matter of the hearing, please provide the following information:

2019

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment
CASG/JSF/CON10869/2	Common Wealth of Australia	\$ 52,801,706	LM AUS IMAS STAFFING
PO 4440969646	Israel Ministry of Defense	\$ 31,000,000	ISRAEL TRAINING CENTER PO - OCONUS
PO 4441017193	Israel Ministry of Defense	\$ 14,000,000	ISRAEL TRAINING CENTER PO - CONUS
LPT/50125	UK Ministry of Defense	\$ 3,456,345	FOA WORKSTREAM II - SUSTAINMENT FACILITIES
MHI-COM-TOOLING-2016	Mitsubishi Heavy Industries, Ltd.	\$ 2,944,719	JAPAN FACO TOOLING SUPPORT

2018

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment
NO. 548	Italian Ministry of Defense	\$ 93,072,334	F-35 ITALY FINAL ASSEMBLY AND CHECKOUT (FACO)
MHI-COM-TOOLING-2016	Mitsubishi Heavy Industries, Ltd.	\$ 4,132,729	JAPAN FACO TOOLING SUPPORT
MC-2018-001	Mitsubishi Corporation	\$ 3,750,000	MC AMCPO SUPPORT
0002-TECH SERVICES	Elbit Systems - Cyclone Ltd	\$ 875,000	LM/CYCLONE TECHNICAL SERVICES CONTRACT
PO 4440908383	Israel Ministry of Defense	\$ 820,003	MITIGATION OCONUS PO

2017

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment
NO. 548	Italian Ministry of Defense	\$ 25,614,867	F-35 ITALY FINAL ASSEMBLY AND CHECKOUT (FACO)
MHI-COM-TOOLING-2016	Mitsubishi Heavy Industries, Ltd.	\$ 7,992,000	JAPAN FACO TOOLING SUPPORT
LPT/50125	UK Ministry of Defense	\$ 4,271,972	FOA WORKSTREAM II - SUSTAINMENT FACILITIES
0002-TECH SERVICES	Elbit Systems - Cyclone Ltd	\$ 1,869,000	LM/CYCLONE TECHNICAL SERVICES CONTRACT
WHOCONUS-PO4440758740	Israel Ministry of Defense	\$ 1,210,000	ISRAEL WH SERVICES - OCONUS

Fiduciary Relationships: If you are a fiduciary of any organization or entity that may have an interest in the subject matter of the hearing, please provide the following information:

Organization or entity	Brief description of the fiduciary relationship
N/A	N/A

Organization or Entity Contract, Grant or Payment Information: If you or the entity you represent before the Committee on Armed Services has contracts or grants (including subcontracts or subgrants) or payments originating from an organization or entity, whether public or private, that has a material interest in the subject matter of the hearing, received during the current and two previous calendar years, please provide the following information:

2019

Contract/grant/ payment	Entity	Dollar value	Subject of contract, grant or payment
N/A	N/A	N/A	N/A

2018

Contract/grant/ payment	Entity	Dollar value	Subject of contract, grant or payment

2017

Contract/grant/ payment	Entity	Dollar value	Subject of contract, grant or payment

STATEMENT OF
MATTHEW F. BROMBERG
PRESIDENT, PRATT & WHITNEY MILITARY ENGINES
BEFORE THE HOUSE ARMED SERVICES COMMITTEE
JOINT READINESS & TACTICAL AIR AND LAND FORCES
SUBCOMMITTEE HEARING ON F-35 PROGRAM UPDATE: SUSTAINMENT,
PRODUCTION, AND AFFORDABILITY CHALLENGES
NOVEMBER 13, 2019

NOT FOR PUBLICATION UNTIL RELEASED BY

Chairman Garamendi, Chairman Norcross, Ranking Member Lamborn, Ranking Member Hartzler, and distinguished members of the House Armed Services Committee, thank you for the opportunity to appear before you today to share Pratt & Whitney's role in producing and sustaining the F135, the propulsion system for the F-35 Joint Strike Fighter (JSF). Let me say thank you for the consistent Congressional support for the program, which has enabled us to produce the world's most advanced, combat-proven 5th generation propulsion system. I also want to acknowledge Under Secretary Lord and Lieutenant General Fick for their support of the program. And, I wish to publicly recognize the Lockheed Martin team for their partnership with Pratt & Whitney.

A Legacy of Dependable Engines

For nearly a century, Pratt & Whitney has partnered with the Department of Defense, the warfighter, and our industry partners to provide game-changing propulsion for cutting-edge military aircraft. From the 369,000 Wasp engines produced in World War II, to the approximately 200 F135 engines we'll deliver in 2020, every one of our engines bears a Pratt & Whitney seal that proclaims two words: Dependable Engines. Today, 42,000 Pratt & Whitney associates treasure and live to uphold that legacy. Of our core values, safety, integrity, and innovation are evident in every engine we produce. Our commitments and culture remain informed and reinforced by our close personal ties with our warfighting customers -- nearly 25 percent of our employees are veterans or actively serving in the Reserve and National Guard. We recruit veterans because they share the values of Pratt & Whitney, they understand the warfighter, and because it's the right thing to do. Our focus today and tomorrow remains

squarely on supporting the warfighter, meeting critical mission requirements, and doing so in a manner that safeguards the best interests of the warfighter and the American taxpayer.

The F135 Today

The F135 propulsion system is the world's most advanced fighter engine, delivering more than 40,000 pounds of thrust and unmatched advances in safety, design, performance, and reliability. With 10 years of development and initial operating experience, the pilot and maintainer feedback is positive. We evolved the F135 from the proven F119 engine, which powers the F-22 Raptor. Together, the F135 and F119 represent the only combat-proven 5th generation engines in the world. Since powering the F-35's first flight in December of 2006, the F135 has maintained the highest levels of safety and readiness enabling the JSF program to meet flight test objectives and the declaration of Initial Operational Capability.

Today, we are proud that the F135 continues to set standards in terms of performance, reliability, maintainability, and cost. The F135 has demonstrated unmatched engineering achievements and performance capability. Moreover, the requirement to leverage a common engine and apply it to three variants has resulted in significant economies of scale in development, production, and sustainment. While we are proud of the F135 accomplishments to date, we are committed to continuous improvement in performance, production, sustainment, and life-cycle cost effectiveness.

Production and affordability are top program priorities. To date, we have produced over 500 F135 engines. In 2019, as we transition from low-rate initial production (LRIP) into full-rate lot production, we have a good opportunity to reflect on the progress to date, challenges faced, and opportunities to further improve. While the engine has been in production for 10 years, the

major production ramp has occurred only in the past 24 months. In 2019, we are on track to produce our contracted engines, which will represent a significant volume increase over the 2018 output. While we spent years preparing for the rate increase, the ramp was challenged by internal and external supply chain capacity constraints in light of significant aerospace market growth. In response, Pratt & Whitney and suppliers invested over \$500 million in capital and process improvements to enable the increase in output and to create surge capacity in critical areas. In 2020, we aim to achieve a production rate of approximately 200 engines per year, which will remain steady for the program of record.

From a cost perspective, Pratt & Whitney has reduced the average cost of an F135 by 50 percent. While we are pleased with our progress to date, we recognize the imperative to drive further cost reduction. Through a 10-year combined Pratt & Whitney and U.S. Government funding program entitled Pratt's War on Cost, Pratt & Whitney delivered propulsion system contract costs consistent with targets while providing an estimated \$7 billion in cumulative program savings. These efforts contributed directly to the F-35 unit fly-away cost of \$80 million. To achieve these reductions, Pratt & Whitney executed over 2,000 cost-reduction initiatives focused on value-engineering, supplier long-term agreements (LTA) that leverage our commercial and military volume, and finding best-value suppliers in our domestic and international partner base. In addition, starting with LRIP 4, and continuing with our current contract, Pratt & Whitney operates under a fixed price incentive fee contract structure. This aligns incentives between Pratt & Whitney and the F-35 Joint Program Office (JPO). Lastly, to protect schedule and price, Pratt & Whitney has been ordering parts from the supply chain in advance of program funding -- this allows us to protect capacity and pricing in a constrained supply environment.

Looking forward, we recognize that our cost reduction strategy needs to continue to adapt to several challenges. Because a significant portion of the F135 is sourced from domestic and international suppliers, the bulk of our opportunity resides in the supply base. The global aerospace supply base is experiencing the most significant demand increase in a generation. In addition, many of the F135 parts are specialized value streams leveraging exotic materials and manufacturing techniques unique to the high-performance F135 engine. Given that environment, we have launched a multifaceted strategy. First, we will continue the value-engineering tasks and supply chain leverage that have been successful to date. Second, we will continue to develop domestic and international alternatives to existing suppliers. This is a multi-year effort, but will serve the industry well in terms of capacity and competition. Third, there are unique parts in the F135 that will benefit from advances in digital engineering, automation, additive manufacturing and process certification. Many of these initiatives will require flexibility in contracting as the pay-back for cost reduction may not be achieved in short-term contract cycles. As we have done in the past, Pratt & Whitney will work with the Joint Program Office to identify new strategies to further reduce cost. It is important, however, that this be a shared responsibility. U.S. Government support is needed as we work together to continue down the path of cost reduction and savings. To that end, it is important for Congress to provide budget stability and certainty by passing both the defense authorization and appropriations bills. This is required so that we can plan and execute long-term cost reduction programs, and Pratt & Whitney can continue to secure capacity and favorable pricing in the supply base.

With a worldwide fleet of approximately 500 F135 engines that is expanding rapidly, Pratt & Whitney is laser-focused on executing world-class sustainment to maintain mission capability and to achieve cost performance targets. The first and most important element of

effective sustainment is engine reliability. In this regard, the F135's initial performance is setting a high benchmark in terms of mission capability and reliability. In surpassing over 200,000 flight hours across the global fleet of all three U.S. Services, three partner countries, and two allied FMS customers, Pratt & Whitney and the F135 have maintained mission capability rates consistently exceeding 94 percent. For reliability, the F135 is 10 times more reliable in service than the F100 was when it achieved the same 200,000 engine flight hour milestone. In addition, the dependable F135 has demonstrated an over 250 percent improvement in Unscheduled Engine Removals rate (UER) over 4th generation engines. However, our legacy engine experience has taught us that even the most sophisticated engines must continue to adapt. As a matter of standard practice, Pratt & Whitney continuously monitors the fleet and performance, and its world-class team of engineers develops improvement projects to ensure we maintain the highest levels of reliability. These projects need funding with a long-term vision. We support, and have requested full funding of the Component Improvement Program (CIP) as a key enabler of continued safe and dependable operation. These investment dollars are critical to resolving reliability issues early and cost effectively.

The second key driver in cost effective sustainment is program-managed operational and depot maintenance. The F135 engine is designed with supportability features to ease operational maintenance while achieving unprecedented engine reliability and sustainability. These features include the most advanced engine health monitoring systems, advanced prognostics capabilities, specially designed inspection and maintenance features, and a well-stocked sustainment pool of parts. The F135 program is equally focused on effective depot maintenance through work scope management, part consumption and maintenance cost. Pratt & Whitney, through its Public-Private Partnership with Tinker Air Force Base, has a strong track record in working depot

efficiencies. We need to jointly fund the continued development of an F135 engineering team at Tinker Air Force Base to work engine and repair line process enhancements. This model has been very successful in the past, and will serve as a key enabler for the F135. As material costs are a major driver of sustainment costs, our engine cost reduction program mentioned above will pay huge dividends in the lifecycle cost as parts are replaced during normal scheduled maintenance. Lastly, and unique to the F135, is the positive impact the global Performance Based Logistics (PBL) will have in terms of economies of scale in tooling, parts, modules and maintenance burden.

Sustainment execution will also benefit from digital technologies. Pratt & Whitney's Digital Depot and Fleet Command initiatives will bring advanced capabilities to the maintainer. For example, the Digital Depot will provide more accurate part inspections and digital records. Both will improve depot throughput, while enabling more rapid, accurate and cost-effective depot management. The Fleet Command program will centralize all key data points on the program to allow fleet managers visibility into depot modules and part status which will optimize fleet logistics.

The F-35 Joint Program Office has established cost per flight hour and cost per tail per year sustainment targets. As the fleet grows, we are committed to affordable sustainment for the F135, and are targeting a 50 percent reduction in cost per flight hour to meet a goal of \$3,500 per flight hour. To this end, Pratt & Whitney is engaged in, and fully supports, the Joint Program Office led "180 Day Sprint" initiative. We are working closely with our program and industry partners to address a range of challenges, accelerate critical tasks, and drive early cost reduction actions.

As Pratt & Whitney strives to keep F135 sustainment affordable, it is critical that our contracting strategy is aligned with the mission. Our current sustainment contract, PBL 1, will expire in December 2020. As we look to its successor, we need to collaborate on organic and directed sourcing ideas. As mentioned above, Pratt & Whitney has a strong history of public-private partnerships and with working across all government agencies. To maximize the benefits of these partnerships, Pratt & Whitney would like to collaborate in sourcing decisions impacting the F135 to ensure they within the best interest of program objectives. Directed sources, if not executed flawlessly, can have unintended consequences in terms of readiness, cost and efficiency. Finally, sustainment execution and cost reduction is not a short-cycle business. We need to work collaboratively with the Joint Program Office to find creative, longer-term maintenance contracts to allow us to jointly plan for and execute sustainment readiness and cost reduction.

We know sustainment -- it is a core competency. We support more than 100,000 engines around the world between our commercial and military franchises. Based on Pratt & Whitney's broad experience and long history with service contracts across our military and commercial product lines, we believe that key sustainment elements such as supply chain management, forecasting and maintenance planning, and sustaining engineering should fall under the engine integrator. We look forward to collaborating with the Joint Program Office and our warfighting customers to optimize our sustainment relationship and develop a flexible contracting approach to meet readiness and affordability objectives.

F135 Modernization

With development of the baseline JSF program complete, the program is now focused on modernization. These initial efforts are collectively known as Block 4. It is important to assure

that the growth in aircraft capability is met with matched propulsion modernization. Fortunately for our customers, the F135 is amply designed to serve as the foundation for any growth in aircraft capability. Pratt & Whitney is working closely with the Joint Program Office and Lockheed Martin to develop a propulsion roadmap to support defined and undefined Block 4 capability requirements. Our Enhanced Engine Program approach enables us to insert next-generation propulsion technologies into current platforms as they become available. This will provide our customers with a full range of performance improvement options to keep them ahead of evolving threats. Our aim is to get mature technologies into the hands of the warfighter quickly -- from development to fielding -- through rapid, iterative upgrades. We have a good track record of such upgrades, and support funding for F135 enhancements.

Conclusion

In conclusion, the current and future success of the F135 engine program depends on collaboration and partnership between Pratt & Whitney and the U.S. Government. The F135 is important both to our national security and to our economic strength. As noted, the F-35 and F135 supports, aligns, and plays an integral role in the Defense Department's National Defense Strategy, with its 5th generation capabilities providing the warfighter with a vital advantage over our adversaries. In addition, the F135 is supporting more than 33,000 jobs, across 31 states. We remain laser-focused on meeting our production commitments, achieving sustainment affordability, and investing in propulsion growth initiatives, while providing the best value to the taxpayer and the most effective and reliable systems to the warfighter.

Thank you again for the opportunity to appear before your subcommittees.

Matthew F. Bromberg
President, Military Engines, Pratt & Whitney

Matthew Bromberg is president of Pratt & Whitney's Military Engines business where he oversees development, production, and support of the company's military offerings including the 5th generation F119 and F135 engines for the F-22 and F-35 fighters, the F100 for the F-15/F-16, the F117 for the C-17, the PW4062 for the KC-46A, P&W's Military APU portfolio, and its small engine business. He is also responsible for B-21 bomber engine development and P&W's adaptive engine portfolio for future combat aircraft.

Prior to his current role, Matthew served as president of Pratt & Whitney's Aftermarket business. In this role, Matthew had responsibility for worldwide support of operational Pratt & Whitney and IAE engines. This included engine overhaul centers, part repair centers and material solutions.

Matthew has served in positions of increasing responsibility at the United Technologies Corp. corporate office, Pratt & Whitney, and at Hamilton Sundstrand since joining United Technologies in 2002. Prior to joining Pratt & Whitney, he was vice president of Corporate Strategy and Development for United Technologies Corp., where he led the successful portfolio transformation.

Matthew currently serves on the board of the United Service Organizations of Metropolitan New York and is the executive sponsor of "UTC-4-Vets", an employee resource group for veteran employees of Pratt & Whitney and United Technologies. Before joining United Technologies, Matthew worked as an investment banker at Goldman Sachs and served five years as a nuclear-trained submarine officer in the U.S. Navy.

Matthew holds a Master of Business Administration degree from the Sloan School of Management at Massachusetts Institute of Technology (MIT), a Master of Science degree in Mechanical Engineering from MIT, and a Bachelor of Arts degree in Physics from the University of California, Berkeley.

Pratt & Whitney is a world leader in the design, manufacture and service of aircraft engines and auxiliary power units. United Technologies Corp., based in Farmington, Connecticut, provides high-technology systems and services to the building and aerospace industries. To learn more about UTC, visit the website at www.utc.com or follow the company on Twitter: [@UTC](https://twitter.com/UTC).

**DISCLOSURE FORM FOR WITNESSES
COMMITTEE ON ARMED SERVICES
U.S. HOUSE OF REPRESENTATIVES**

INSTRUCTION TO WITNESSES: Rule 11, clause 2(g)(5), of the Rules of the U.S. House of Representatives for the 116th Congress requires nongovernmental witnesses appearing before House committees to include in their written statements a curriculum vitae and a disclosure of the amount and source of any federal contracts or grants (including subcontracts and subgrants), or contracts or payments originating with a foreign government, received during the current and two previous calendar years either by the witness or by an entity represented by the witness and related to the subject matter of the hearing. As a matter of committee policy, the House Committee on Armed Services further requires nongovernmental witnesses to disclose whether they are a fiduciary (including, but not limited to, directors, officers, advisors, or resident agents) of any organization or entity that may have an interest in the subject matter of the hearing. Committee policy also requires nongovernmental witnesses to disclose the amount and source of any contracts or grants (including subcontracts and subgrants), or payments originating with any organization or entity, whether public or private, that has a material interest in the subject matter of the hearing, received during the current and two previous calendar years either by the witness or by an entity represented by the witness.

Please note that a copy of these statements, with appropriate redactions to protect the witness's personal privacy (including home address and phone number), will be made publicly available in electronic form not later than one day after the witness's appearance before the committee. Witnesses may list additional grants, contracts, or payments on additional sheets, if necessary. Please complete this form electronically.

Hearing Date: Wednesday, November 13, 2019

Hearing Subject:

F-35 Program Update: Sustainment, Production, and Affordability Challenges

Witness name: Matthew F. Bromberg

Position/Title: President, Military Engines, Pratt & Whitney

Capacity in which appearing: (check one)



Individual



Representative

If appearing in a representative capacity, name of the organization or entity represented:

Pratt & Whitney division of United Technologies Corporation

Federal Contract or Grant Information: If you or the entity you represent before the Committee on Armed Services has contracts (including subcontracts) or grants (including subgrants) with the federal government, received during the current and two previous calendar years and related to the subject matter of the hearing, please provide the following information:

2019

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant
N00019-20-C-0005-0004	Department of Defense	\$309,357,445	Supplies, services and planning for F135 depot activations
N00019-16-G-0002-N0001919F2849	Department of Defense	\$7,061,500	Services to support site activation
N00019-16-G-0002-N0001919F0003	Department of Defense	\$75,579.96	Services to support site activation
N00019-16-G-0002-N0001919F2616	Department of Defense	\$3,077,126	F135 depot maintenance activation planning services
N00019-17-G-0008-N0001919F4082	Department of Defense	\$1,390,805.85	Implementation of an engineering change

2018

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant
N00019-18-C-1069	Department of Defense	\$266,062,462	Supplies, services and planning for F135 depot activations
N00019-18-C-1021	Department of Defense	\$239,691,085.45	Production of F135 propulsion systems
N00019-16-G-0002-N0001918F0591	Department of Defense	\$499,122	Support services for foreign military sales
N00019-16-G-0002-N0001918F2007	Department of Defense	\$1,448,288	Support services for foreign military sales
N00019-16-G-0002-N0001919F2518	Department of Defense	\$872,568.60	Implementation services for customs warehouse

2017

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant
N00019-17-C-0010	Department of Defense	\$399,788,883	F135 performance based logistics sustainment
N00019-16-G-0002-0002	Department of Defense	\$3,060,848	F135 performance based logistics sustainment
N00019-16-G-0002-0003	Department of Defense	\$3,057,195	F135 depot maintenance activation planning services
N00019-16-G-0002-0004	Department of Defense	\$2,068,458	F135 depot maintenance activation planning services
N00019-17-G-0005-N0001918F2412	Department of Defense	\$21,631,613	F135 component improvement program for 2017

Foreign Government Contract or Payment Information: If you or the entity you represent before the Committee on Armed Services has contracts (including subcontracts or subgrants) or payments originating from a foreign government, received during the current and two previous calendar years and related to the subject matter of the hearing, please provide the following information:

2019

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment
None			

2018

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment
None			

2017

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment
Agreement Number 13516100100	Netherlands Ministry of Defence	\$32,328,117	Test cell construction

Fiduciary Relationships: If you are a fiduciary of any organization or entity that may have an interest in the subject matter of the hearing, please provide the following information:

Organization or entity	Brief description of the fiduciary relationship
Pratt & Whitney division of United Technologies Corporation	President, Military Engines

Organization or Entity Contract, Grant or Payment Information: If you or the entity you represent before the Committee on Armed Services has contracts or grants (including subcontracts or subgrants) or payments originating from an organization or entity, whether public or private, that has a material interest in the subject matter of the hearing, received during the current and two previous calendar years, please provide the following information:

2019

Contract/grant/ payment	Entity	Dollar value	Subject of contract, grant or payment
Purchase Order 4400242511	Lockheed Martin Corporation	\$9,083,765	Engineering services for a development program
C-5 Support Agreement	Lockheed Martin Aeronautics	\$771,830	Sustainment engineering support for auxiliary power unit
Purchase Order 6574035518	Lockheed Martin Aeronautics	\$984,879	F-35 Power and Thermal Management System

2018

Contract/grant/ payment	Entity	Dollar value	Subject of contract, grant or payment
Purchase Order 4400239641	Lockheed Martin Corporation	\$100,000	Engineering services for a development program
EXPEDITE Agreement	Lockheed Martin Aeronautics	\$285,099	Engineering services for a development program

2017

Contract/grant/ payment	Entity	Dollar value	Subject of contract, grant or payment
Purchase Order 4400211036	Lockheed Martin Corporation	\$16,078,129	Engineering services for a development program

**Annex to
DISCLOSURE FORM FOR WITNESSES
COMMITTEE ON ARMED SERVICES
U.S. HOUSE OF REPRESENTATIVES**

This Annex provides a disclosure of the unclassified contracts required to be disclosed by Pratt & Whitney as a nongovernmental witness appearing on November 13, 2019, before the House Committee on Armed Services for a hearing on the subject of F-35 Program Update: Sustainment, Production and Affordability Challenges.

Federal Contract or Grant Information:

2019 (Continued from Disclosure Form)

Federal Grant / Contract	Federal Agency	Dollar Value	Subject of Contract or Grant
N00019-17-G-0005-N0001919F0001	Department of Defense	\$71,407,381	F135 component improvement program for 2019
N00019-17-G-0005-N0001919F4018	Department of Defense	\$1,173,540	F135 component improvement program services and testing
N00019-17-G-0005-N0001919F2929	Department of Defense	\$642,035	F135 component improvement program services
N00019-17-G-0005-N0001919F2900	Department of Defense	\$467,521	F135 component improvement program trade study
N00019-17-G-0005-N0001919F2889	Department of Defense	\$943,597	F135 component improvement program services
N00019-19-C-0054	Department of Defense	\$108,000,000	F135 alternate sourcing initiative

2018 (Continued from Disclosure Form)

Federal Grant / Contract	Federal Agency	Dollar Value	Subject of Contract or Grant
N00019-17-G-8008-N0001918F2649	Department of Defense	\$10,529,593	Implementation of an engineering change
N00019-19-C-0007	Department of Defense	\$230,144,943	Testing support for the F135 Block 4 Flight Test Program
N00019-17-G-0005-N0001918F2412	Department of Defense	\$63,499,364	F135 component improvement program for 2018

QUESTIONS SUBMITTED BY MEMBERS POST HEARING

NOVEMBER 13, 2019

QUESTIONS SUBMITTED BY MR. LANGEVIN

Mr. LANGEVIN. FRC East is the largest industrial depot that generates combat air power for both the Marine Corps and Navy variants of the F-35. The buildings at FRC East, like all of the other fleet readiness centers in the United States, continue to lag in upgrades and new construction commitment from the Navy. What is DOD doing to address the sustainability of F-35 in terms of depot upgrades, specifically at FRC East? How should the CNO and the Commandant of the Marine Corps address the future needs of FRC East, which is the only Navy fleet readiness command resident on a Marine Corps air station? The problem of antiquated, legacy maintenance facilities is particularly acute in the Navy. How can the Joint Program Office, the Navy, and the Marine Corps ensure that we continue to commit resources to the right efforts to improve FRC East and their maintenance performance?

Secretary LORD. The Department of the Navy, as outlined in the Commander, Fleet Readiness Centers Infrastructure Optimization Plan (IOP), is not only addressing the sustainability of the F-35, but also the future needs of FRC East (FRCE) by upgrading various depot facilities and equipment. This includes the construction of a new F-35 maintenance hangar, and the construction of an advanced composites repair facility in addition to numerous other MILCON projects. The IOP requests a rough order of magnitude investment of \$3.5 billion over the next decade. Of this total, approximately \$1.5 billion is required for MILCON projects, an estimated \$1 billion for sustainment, restoration, and modernization of facilities, and roughly \$1 billion for equipment recapitalization. Modernization will enable the depots to fulfill their current production requirements and achieve the production objectives within the COMFRC Strategic Plan. The Joint Program Office, the Navy, and the Marine Corps, to include the Chief of Naval Operations and the Commandant of the Marine Corps, understand the importance of FRCE to the F-35 Program, along with the other naval aviation depot support that FRCE provides, and will work together to determine the best way forward to realize the requirements laid out in the IOP.

Mr. LANGEVIN. FRC East is the Navy's only depot dedicated to maintaining the F-35B and if need, the F-35C. FRC East resides on a USMC installation, MCAS Cherry Point. However, FRC East is owned by the Navy, specifically, Naval Air Command (NAVAIR). FRC East requires significant investments to build and modernize facilities there to maintain the F-35. There appears to be some disagreement between the Navy and Marine Corps over who is responsible for paying to upgrade facilities at FRC East. I am concerned this argument is delaying progress. Which service is responsible for funding the needed construction and modernization efforts at FRC East? The Navy or the Marine Corps?

Secretary LORD. The Department of the Navy is responsible for funding construction and modernization efforts at all Fleet Readiness Centers (FRC)s. In support of the F-35B and F-35C Fleet, and the required facilities at FRC East, the Navy and Marine Corps are working an acceptable solution agreeable to both parties. The DON will provide an update once this agreement is completed, estimated to be NLT the 3rd/4th QTR CY2020 timeframe.

Mr. LANGEVIN. The facilities at our depots that are being used to maintain the F-35 were designed for 2nd and 3rd generation aircraft. That is to say, they were built in the 1940s and 50s. A 5th generation fighter needs modern maintenance facilities. Otherwise, I do not believe we will be able to sustain the F-35 in a war against a near-peer adversary. Does the Navy and Air Force have a comprehensive plan to modernize the depots being used to maintain the F-35? If so, what is that plan and what is the timeline for implementation?

Secretary LORD. Yes the Navy and Air Force have a comprehensive plan to modernize the depots.

For the Navy, COMFRC is modernizing all three Depots in support of F-35 aircraft, engines, and components. COMFRC's Infrastructure Optimization Plan (IOP) provides a roadmap to update the Industrial Depot's facilities and equipment to support both legacy and fifth generation weapon systems. Phase 1, completed in 1st quarter 2019, included an initial baseline assessment of the Depot's most critical

production and manufacturing facilities and critical equipment. Phase 1 identified an estimated \$3.5B requirement over 10 years (roughly \$1.5B Military Construction (MILCON), \$1B Sustainment, Restoration, and Modernization (SRM), and \$1B Industrial Support Equipment). COMFRC's Phase 1 Report to Congress was submitted in April 2019. IOP Implementation is already underway. We received initial FY19 and FY20 Industrial Support Equipment funding as well as approval to increase rates in FY21 to fund the SRM requirements. We also continue to compete for MILCON funding through the Navy MILCON program.

In 2018, the Air Force accomplished a comprehensive baseline assessment and developed a 20-year roadmap for modernizing all three organic depots to support legacy and fifth generation weapon systems. The Air Force plan identified requirements stratified across 4 dimensions (IT/industrial software, equipment/technology, facilities, and infrastructure). In 2019, the Air Force began leveraging the U.S. Army Corps of Engineers (USACE) to refine our plan and optimize our industrial processes. Our leadership is working Planning Choices via Air Force corporate structure for prioritization of funding options. We continue to compete for MILCON funding to support legacy and fifth generation weapon systems beyond FY28.

Mr. LANGEVIN. According to a June 2018 GAO report, the Department was planning to defer fixes for some of the F-35's deficiencies until after a full-rate production decision. Category 1 deficiencies are those that could jeopardize safety, security, or a critical requirement for the aircraft. Will you approve full-rate production with Category 1 deficiencies still open?

Secretary LORD. The twelve open F-35 Category 1 deficiencies (as of 9 December 2019) are summarized below, along with the rationale for proceeding with a full-rate production decision. Although #5 will require a small hardware modification for customers who desire a solution, all other planned actions for these deficiencies are being phased to coincide with planned software updates.

1. F-35B Tailboom & Horizontal Tail Damage During Sustained Supersonic Flight: All missions can be accomplished while complying with the time limit imposed at the high-speed edge of the flight envelope. There is no evidence to-date of any significant sustainment issues due to exceedance of the time limit.

2. F-35C Tailboom & Horizontal Tail Damage During Sustained Supersonic Flight: All missions can be accomplished while complying with the time limit imposed at the high-speed edge of the flight envelope. There is no evidence to-date of any significant sustainment issues due to exceedance of the time limit.

3. Hydraulic line rupture caused by a blown tire: There have been no operational observances of this issue to date. The System Safety Risk Assessment concluded that the design is compliant (low risk) and does not need further mitigation.

4. Radar Sea Search limited to a small pre-designated area: U.S. services concurred with the design for Sea Search in 2014 and the fielded baseline meets these requirements. Follow-on improvements for Sea Search are planned for 2024 and require enhanced processing capability, enabled through Block 4.

5. Cabin Over-pressurizations Create Conditions Possible to Induce Barotrauma: There have been no operational observances of this issue to date. The System Safety Risk Assessment concluded that the design is compliant (low risk). An improvement to cockpit pressure regulation is under investigation, but has yet to be flight tested.

6. Unanticipated thrust limits in jetborne flight on hot days: Significant improvements have been made with vehicle and engine software updates in 2019, and with enhanced fleet procedures. Additional software updates in mid-2020 will restore compliant engine performance for F-35B.

7. Obscured Night Vision Camera scene during below-mean starlight ambient lighting conditions: No alternative technology is ready for implementation today, requiring use of shipboard lighting on very dark nights. A software improvement will be attempted in mid-2020.

8. Incorrect inventory data for complex assemblies continues to result in grounding conditions: Ongoing data quality issues with information stored in the Autonomous Logistics Information System (ALIS) may cause occasional delays in releasing aircraft for flight. Data quality improvements continue to be worked.

9. Lack of DTED Elevation Data for Pilot Entered Waypoints: The pilot interface was concurred with by services during system design, but this issue was identified during operational test. Software resolution is expected in mid-2020.

10. SINS alignments aboard QE class carriers fail to achieve mission capable solution: A workaround solution of in-motion alignment has been successfully used aboard HMS Queen Elizabeth during recent events. Software solution for SINS cable alignments will be released in late 2020.

11. Classified DR #445: Details are classified. The solution appears to be a non-F-35 software update planned for mid-2020.

12. Classified DR #494: Details are classified. The solution will be included in an F-35 software update in mid-2020.

Mr. LANGEVIN. You have said in the past that Turkey makes nearly 1,000 parts for the F-35. Do you still expect those Turkish suppliers to be replaced by March 2020?

Secretary LORD. The F-35 Joint Program Office (JPO) is working with Lockheed Martin and Pratt & Whitney to develop, identify and qualify alternative sources for 817 air vehicle parts (~3% of bill of material) and 188 propulsion parts (6% of bill of material) currently made in Turkey so that they may also be removed from the supply chain. The U.S. Services have provided \$589M for this activity, which began in March 2019. Plans are underway to transition the majority of parts in the Turkish supply chain by March 2020. Of note, production of six landing gear components, the Center Fuselage, and F-135 Integrally Bladed Rotors (IBRs) do not support an abrupt supply cut-off date of March 2020. The JPO is working mitigation strategies to develop alternative sources to Turkish supply for these parts:

- Six Landing Gear parts are anticipated to be transitioned by the end of December 2020 to alternative sources. Based on current rough estimates, an abrupt March 2020 supply cut-off date for landing gear would disrupt 81 on-time aircraft deliveries. Lockheed Martin is working to mitigate these late deliveries by using a pool of available landing gear until there is a sufficient line of balance with alternate sources.
- The JPO is currently developing courses of action to transfer center fuselage work from Turkey to Northrop-Grumman facilities in Palmdale, CA, where the rest of the center fuselage work is currently executed. The center fuselage is a major component of the F-35 aircraft and full transition to Palmdale requires simultaneously terminating purchase orders in Turkey while preserving work in progress and raw material. These purchase orders pre-date the alternate source activities. Although the schedule impact to aircraft of transitioning center fuselage to Palmdale is much less severe than landing gear, the F-35 Program is seeking alternatives in additional tooling for Palmdale to make up the capacity currently sourced from Turkey.
- The IBR portion of the propulsion system is the long lead component that would pace production after landing gear and center fuselages. The JPO has worked with Pratt & Whitney and USD (A&S) staff to provide funding to procure additional milling machines to manufacture IBRs originally provided by Turkish suppliers. These milling machines will be installed in Pratt & Whitney's Connecticut facility and will increase capacity to support F-35 needs. If the supply of these three parts were disrupted in March 2020, it is foreseeable that we would expect to start seeing aircraft delivery delays within a few months. Although we are aggressively qualifying alternate sources and facilitating them to produce at rate, our current modeling, paced by landing gear, suggests that the impact of a March 2020 supply disruption is estimated to be 81 aircraft delivered after their contracted schedule delivery date. The JPO estimates that maintaining these supply chains until December 2020 would provide the time needed to avoid production line impacts.

Mr. LANGEVIN. Within the F-35 supply chain, do you see manufacturing of spare parts competing with manufacturing of parts for new production aircraft when it comes to industrial base capacity? The military depots should help relieve capacity challenges for the industrial base on parts repairs. However, according to GAO, current projections show the depots will not have the ability to fully meet the demand for repairs until 2024. What steps are you taking in the interim?

General FICK. Manufacturing of parts to meet production and initial spare requirements do compete for existing industrial base capacity today. The requirement for initial spares will grow proportionately with the number of new production aircraft; similarly, we expect the demand for the repair of Line Repairable Units (LRUs) will grow as the fleet grows. The same subcomponents required to produce parts for production and initial spares are also required for the repair of these LRUs. From an F-35 perspective, the primary role of the military depots is the repair of LRUs. Currently, some Original Equipment Manufacturers (OEMs) are also repair facilities. This repair burden competes for capacity with the manufacturing of new parts to support production and initial spare requirements. To alleviate the impact repair places on OEM capacity, the F-35 enterprise (JPO, Lockheed Martin, and Pratt & Whitney) have accelerated activation of organic depot repair capability. To date the depot repair acceleration plan is on track to enable all organic repair activations to reach full rate by 2024. As of 31 December 2019, 30 of 68 Depot Activations have occurred, exceeding our 2019 goal by one workload. In the interim, we are encouraging Lockheed Martin and Pratt & Whitney to enter into discrete Performance Based Logistics agreements and Master Repair Agreements to incentivize

OEMs to invest in repair capability and production capacity of critically in-demand spares. Additionally, in September 2019, the JPO awarded a Special Tooling and Test Equipment (STATE) contract to provide additional resources to meet the anticipated 5-year demand of sustainment, production and modification parts.

Mr. LANGEVIN. I understand that industry is responsible for selecting new vendors that will replace the Turkish supply chain. Where are we in that process? How many of those parts will be production ready through new vendors by March 2020, by which time Turkey will be suspended from the program? If there are new suppliers that will not have contracts in place and be production ready by March 2020, how long can industry maintain current or planned production rates? When could we start seeing delays that impact the production line?

General FICK. Turkey has been suspended from the program. The F-35 Joint Program Office (JPO) is working with Lockheed Martin and Pratt & Whitney to develop, identify and qualify alternative sources for 817 air vehicle parts (~3% of bill of material) and 188 propulsion parts (6% of bill of material) currently made in Turkey so that they may also be removed from the supply chain. The U.S. Services have provided \$589M for this activity, which began in March 2019. Plans are underway to transition the majority of parts in the Turkish supply chain by March 2020. Of note, production of six landing gear components, the Center Fuselage, and F-135 Integrally Bladed Rotors (IBRs) do not support an abrupt supply cut-off date of March 2020. The JPO is working mitigation strategies to develop alternative sources to Turkish supply for these parts:

- Six Landing Gear parts are anticipated to be transitioned by the end of December 2020 to alternative sources. Based on current rough estimates, an abrupt March 2020 supply cut-off date for landing gear would disrupt 81 on-time aircraft deliveries. Lockheed Martin is working to mitigate these late deliveries by using a pool of available landing gear until there is a sufficient line of balance with alternate sources.
- The JPO is currently developing courses of action to transfer center fuselage work from Turkey to Northrop-Grumman facilities in Palmdale, CA, where the rest of the center fuselage work is currently executed. The center fuselage is a major component of the F-35 aircraft and full transition to Palmdale requires simultaneously terminating purchase orders in Turkey while preserving work in progress and raw material. These purchase orders pre-date the alternate source activities. Although the schedule impact to aircraft of transitioning center fuselage to Palmdale is much less severe than landing gear, the F-35 Program is seeking alternatives in additional tooling for Palmdale to make up the capacity currently sourced from Turkey.
- The IBR portion of the propulsion system is the long lead component that would pace production after landing gear and center fuselages. The JPO has worked with Pratt & Whitney and USD (A&S) staff to provide funding to procure additional milling machines to manufacture IBRs originally provided by Turkish suppliers. These milling machines will be installed in Pratt & Whitney's Connecticut facility and will increase capacity to support F-35 needs. If the supply of these three parts were disrupted in March 2020, it is foreseeable that we would expect to start seeing aircraft delivery delays within a few months. Although we are aggressively qualifying alternate sources and facilitating them to produce at rate, our current modeling, paced by landing gear, suggests that the impact of a March 2020 supply disruption is estimated to be 81 aircraft delivered after their contracted schedule delivery date. The JPO estimates that maintaining these supply chains until December 2020 would provide the time needed to avoid production line impacts.

Mr. LANGEVIN. How many open Category 1 deficiencies do you have on the F-35 today?

Mr. BEHLER. The F-35 program has 13 open Category 1 deficiencies that are "In Work & Under Investigation," per the latest Program Office Deficiency Report Metrics, dated 31 October 2019.

QUESTIONS SUBMITTED BY MR. TURNER

Mr. TURNER. Is the dual-capable aircraft (DCA) capability currently on track to meet the NATO need date of January 2024? The original plan was to cut-in DCA capability into Lot 13. Did this happen, and if not, what were the reasons for the delay? Are you experiencing any technical challenges or issues with the development of DCA required software?

General FICK. Yes, the F-35 JPO and DCA stakeholders are on track to meet the accelerated DCA design certification need date of Jan 2023 and NATO operational

need date of Jan 2024. To meet these dates, DCA capability must be incorporated into the 30P05 Operational Flight Program (OFF) production software build that will go into Lot 13 production aircraft. Provided DCA capability is in the 30P05 OFF production software drop, all Lot 13 F-35As will receive this software. The JPO has incentivized Lockheed Martin to expedite delivery of DCA software into Lot 13 production aircraft. DCA stakeholders continually assess the certification processes and timelines since the JPO does not control nor lead some of the major processes such as Weapon System Safety Rules and Operational Certification.

Mr. TURNER. Please provide a status update of the F-35 Hybrid Product Support Integrator (HPSI). When do you expect the HPSI to be fully operational at Wright-Patterson? Are there any challenges or issues with moving the capability from Ft. Worth to Wright-Patterson?

General FICK. The F-35 Hybrid Product Support Integrator (HPSI) achieved Initial Operational Capability in May 2016 and Full Operational Capability in July 2019. The process to relocate all HPSI functions from their current locations to Wright-Patterson Air Force Base (WPAFB) in Dayton, Ohio is ongoing today. The core team—to include the new HPSI Director and Deputy Director—has been stood up at WPAFB with functional areas beginning to transition as early as summer 2020. The HPSI planning team is currently working through challenges associated with continuity of HPSI operations during the transition to mitigate the risk of knowledge and experience loss. This potential attrition of current employees during the move to WPAFB is one of our major concerns. We expect the full transition to WPAFB to be complete in June 2022.

Mr. TURNER. What are you doing to ensure that there are no Chinese parts in their F-35 supply chain? What contractual efforts are you taking to make sure this is the case with your sub-suppliers?

Mr. ULMER. The F-35 Joint Program Office controls the F-35 global supply chain through Lockheed Martin (LM) and Pratt & Whitney's management of contractual requirements. Together with our industry partners the F-35 program closely monitors the F-35 Global Supply Chain in accordance with strict Department of Defense acquisition requirements to ensure no parts or components from unapproved sources are included in delivered products. All F-35 contracts contain these strict acquisition requirements governed by Defense Federal Acquisition Regulations (DFARS) and Federal Acquisition Regulations (FAR) clauses. These clauses are passed down contractually with F-35 suppliers and their sub-tiers and compliance to regulations are certified during negotiations and surveyed in various forms during contract execution.

Lockheed Martin maintains a risk and opportunity management plan to ensure continuous monitoring within the supply chain. The process and tools outlined in this plan provide visibility of potential events before they impact the program in a structured and disciplined manner, including risks and opportunities throughout the LM Aero supply base.

Throughout the procurement lifecycle, we have embedded controls to ensure the integrity of our products from sourcing through contract closeout. During the source selection process, suppliers are required to have the necessary Proprietary Information Agreements, Non-disclosure Agreements, Manufacturing License Agreements, Technical Assistance Agreements, site surveys, etc. Lockheed Martin also restricts sources of supply for certain specialty materials to domestic and Canadian sources. During the selection process, a supplier will not be solicited if they are owned and/or operate in a prohibited country.

In conjunction with the Program Office, Integrated Product Teams, Supply Chain Management (SCM), Lockheed Martin Operations, and other functions, our Supplier Quality Management (SQM) team performs initial supplier reviews, including Quality Systems, Special Processes, and surveys required to identify suppliers approved for procurement. SQM performs on-going supplier control functions, including surveillance of the supplier's performance during manufacturing, to ensure compliance with the terms and conditions of the purchase order, and that consistent supplier quality assurance methods and practices meet program requirements. To defend the customer from counterfeit materiel, during site surveillance, LM Aero anti-counterfeit measures are put in place for prevention, detection, investigation, mitigation and reporting. If any potential non-conforming, counterfeit work, or tampered product were to be identified, the part(s) would immediately be quarantined, prompting an investigation by all appropriate functions to determine the origin of the part(s). For existing suppliers, LM uses all available open source data and some third-party vendors to track parent companies, subsidiaries, and joint ventures, including their country of incorporation. Triggers could be the mention of LM or supplier products with association to a non-qualifying country. Lockheed Martin Supply Chain investigates any potential merger and acquisition that could disrupt or change source of

supply or limit competition. We develop a risk assessment and investigate parent company lineage including connections to China or other non-qualifying countries.

Mr. TURNER. What has industry learned from other fighter programs (i.e., F-22) that you have applied to improve sustainment outcomes for the F-35?

Mr. ULMER. The F-35 industry team applied numerous lessons learned from preceding fighter programs in developing the F-35. These lessons included advancing the design state of the F-22, F-16 and F-117. Specifically, the heart of the F-35's unrivaled situational awareness was derived from the F-22. The F-35's ability to avoid ground collision came from the F-16. The Prognostics and Health Management (PHM) system is an evolutionary cousin of the system employed in the F-22. The F-35 Low Observable (LO) coating system also traces its lineage to the F-117 and F-22. The Autonomic Logistics Information System (ALIS) is derived from the F-22's Integrated Management Information System (IMIS). These evolutions combined to produce the most advanced fighter in history. While these systems are intended to advance the airplane's warfighting capabilities, they also bring significant gains in reliability and maintainability. LRIP 6+ F-35s have the best reliability and maintainability performance in the USAF fighter inventory. By using predecessor aircraft as a starting point, the F-35 design team, many of whom transitioned from F-16 and F-22, were able to improve on high performing designs to gain an operational edge. The avionics suite takes advantage of improved cooling system performance as well as improved speed and throughput to provide the pilot with unparalleled battlefield performance. With each successive Low Rate Initial Production lot, we've seen improved performance and fewer failures as parts remain on the jet longer. More than 59% of the parts on the aircraft have never failed, and more than 84% are exceeding planned reliability. The improved PHM system aids maintainers in detecting and troubleshooting faults, and the design team continues to introduce improved fault detection and isolation techniques. The most recent software version reduced unwarranted parts replacements by more than 70%. The first generation of LO materials used on the F-117 were vastly improved with the introduction of the F-22, but that coating system employs materials that require hours to cure. By comparison, the F-35 coatings represent another full cycle of improvement and have reduced cure times significantly. As a result, the F-35's LO performance on all three variants is more than double the design requirements for all production lots. This results in unscheduled maintenance actions for the LO system occurring only half as often as the design requirement. Further, ongoing advances in coatings and processes will continue to reduce the LO burden on maintenance. The engineering team continues to advance these designs by introducing faster cure times and material improvements that will continue to reduce maintenance manhours per flying hour. Finally, ALIS has drastically improved on IMIS in terms of the capabilities it brings to the flight line and in terms of fleet management. That said, ALIS is operating on a technology base equivalent to the flip phones used in the early 2000s. In order to keep pace and maximize warfighter support, the industry team is supporting DOD in a major redesign of ALIS with a goal toward enabling true agility in software support taking advantage of the IT advancements over the past decade. Taken together, these advances have resulted in a 17% improvement in Mission Capable (MC) Rate for the Combat Coded aircraft over the last year and enabled deployed units in the Middle East to achieve Full Mission Capable Rates exceeding 90% during their recent 6-month deployment all while taking advantage of data fusion technologies initiated on the F-22, that today provides unprecedented battlespace awareness and connectivity in the F-35 to not only the pilot; but the air, land, and sea assets available within the battlespace. Without the basic design elements from the F-35's ancestors, this level of performance improvement would not have occurred. The industry team is fully committed to continuing enhancements that will allow the F-35 to excel against the rapidly advancing threats our adversaries are fielding.

Mr. TURNER. What are you doing to ensure that there are no Chinese parts in their F-35 supply chain? What contractual efforts are you taking to make sure this is the case with your sub-suppliers?

Mr. BROMBERG. Pratt & Whitney ("P&W") recognizes and remains compliant with applicable regulatory and contractual restrictions on sourcing F135 parts from the People's Republic of China ("China"). P&W does not presently procure any F135 parts from suppliers in China.

P&W is subject to U.S. export-control regulations that restrict sourcing certain items from China. Specifically, the International Traffic in Arms Regulations ("ITAR") and the Export Administration Regulations ("EAR") establish license requirements, and corresponding policies of license denial, for exports to China of items (including technical data and software) controlled under the ITAR's U.S. Munitions List or the "600 series" of the EAR's Commerce Control List. In practice,

these export controls preclude P&W from sourcing ITAR or 600-series hardware from China by prohibiting the exchange of technical data necessary for the design and manufacture of the hardware.

Beyond the regulations that govern international trade controls, F135 contracts awarded to P&W include terms and conditions that restrict the sourcing of parts from China, in particular the contract clause at DFARS 252.225-7007, Prohibition on Acquisition of Certain Items from Communist Chinese Military Companies (DEC 2018).

P&W complies with the export-control regulations and contractual sourcing requirements that restrict sourcing of F135 parts from China. To that end, P&W's procurement processes involve multiple layers of controls to identify and prevent procurement of ITAR or 600-series hardware from Chinese suppliers. First, P&W's due-diligence program for on-boarding new hardware suppliers requires each new supplier to complete an online questionnaire developed by TRACE International. This questionnaire requires each supplier to provide business ownership and operational information so that P&W can, among other things, assess the legality of procuring hardware from that supplier. Following the initial screening process, if P&W proceeds to engage the supplier, P&W requires the supplier to agree to standard terms and conditions that require, among other things, compliance with applicable law, including U.S. export-control regulations.

Further, as an automated control, P&W utilizes an Enterprise Resource Planning ("ERP") software system with procurement functionality that blocks issuance of purchase orders to non-U.S. suppliers if P&W does not have an applicable export license or other authorization. This software provides an added safeguard against unauthorized sourcing of ITAR or 600-series items from China.

With respect to sub-suppliers, P&W's supply chain is independently subject to the same regulatory restrictions described above. P&W facilitates compliance throughout the supply chain by indicating how its technical data disclosed to suppliers is controlled for export-control purposes. As noted above, P&W's contracts with suppliers require suppliers' compliance with applicable law, including U.S. export-control regulations. Further, P&W flows to suppliers the mandatory clauses (which by their terms must be flowed by suppliers to sub-suppliers) and other relevant clauses that appear in P&W's F135 prime contracts, including those that impose restrictions on sourcing F135 parts from China.

Mr. TURNER. What has industry learned from other fighter programs (i.e., F-22) that you have applied to improve sustainment outcomes for the F-35?

Mr. BROMBERG. The F135 program benefits from all current and prior military and commercial engine programs at Pratt & Whitney (P&W). P&W actively shares lessons learned across multiple disciplines to create an environment that supports rapid advancements and calculated risk-taking. The F119 is the engine whose architecture is most closely related to the F135 engine. While the support structure for the F119 is less complex than the F135, the F119 has recently experienced its first scheduled depot maintenance wave, providing valuable learnings for the F135 program as it approaches first scheduled depot maintenance visits in 2021.

The F135 program has evaluated and adopted numerous lessons learned from the F119 program. The following information is a summation of the more impactful opportunities in three key areas: people, process, and parts. P&W continues to focus on affordable readiness with a clear priority of always having the right part available, at the right place, at the right time—a core sustainment principle.

People P&W manages programs based upon a matrixed structure which integrates disciplines from across the company into part-family teams. These teams are led by an engineer who has cradle-to-grave responsibility for his or her part family. The F119 program taught us that such a matrixed part family team was necessary for efficiently managing parts through the complexity of sustainment, including the integration of requirements for part distress limits, repair requirements, new parts, and the capacity to perform maintenance. The part family sustainment team lead manages priorities for parts through all phases of sustainment, including preparation for first scheduled depot maintenance. This team has proven invaluable to the F119 and F135 programs, and our new commercial programs have adopted a similar approach.

An additional resource that has proven invaluable to the F135 program and is widely utilized across all other P&W engine programs is our Field Service Representatives. Embedded with each unit is a highly skilled P&W technical leader with knowledge of engine maintenance, technical data interpretation, distress mode evaluation, propulsion system diagnostics, and many other competencies. These individuals are capable of assisting the operators and maintainers to achieve effective readiness outcomes. Moreover, they impact affordability positively by supporting proactive maintenance decisions that can result in an engine's staying on wing

versus being removed or that can allow a field team to perform maintenance locally in lieu of a depot visit for an engine.

Processes Scheduled depot maintenance relies upon a complex integration of parts that are determined to be serviceable as is, require repair, or require replacement. Depending on the engine module, this integration can span hundreds to thousands of parts. The F119 program adopted concepts from a process utilized by the U.S. Air Force to manage depot maintenance known as Depot Repair Enhancement Program (DREP), which evaluates part supportability related to depot maintenance plans. P&W created processes and tools to evaluate part demands for each engine module, identify gaps, and manage gap closure focused on short-, mid-, and long-term supportability. This supportability process assists with prioritization of actions, shows clear ownership of those actions, and is a standard communication tool to use both internally and externally. The F135 program is integrating these processes and tools into our standard work and is expanding upon them to enable use across the entire F135 global depot network (which represents an additional complexity versus the F119, which has one depot at the Oklahoma City Air Logistics Complex). The F135 team has also benchmarked other P&W engine programs such as the F117 program and our commercial programs to learn how to optimize the management of engines/modules through a global depot network. We have evaluated the tools they use and processes for prioritization and logistics efficiencies.

Parts Scheduled depot maintenance occurs when a limit on flight hours, cycles, time, or specified deterioration has been reached. Limits drive an inspection or replacement of parts to maintain the performance and safety specifications of the engine. Parts that require inspection to remain in service must have published technical data, including deterioration limits, for depot inspectors to utilize. The F135 program has learned the value of having these limits established prior to the first depot visit, as well as the value of a streamlined approach to limit expansion and new limit generation to enable timely part dispositions. The most efficient means of reducing depot costs is to reuse parts, and the second-most-efficient means of reducing depot costs is to repair parts. The readiness of sources to perform piece-part repairs was a valuable lesson learned from F119. Fifth-generation engine hardware that makes up the F119 and F135 engines requires some of the most advanced manufacturing processes in aerospace. These same precise and challenging processes are used to repair fifth generation engine piece parts. Dual-sourcing complex repairs, executing multi-step repairs in single locations, utilizing highly efficient sources for high-volume/low-complexity repairs, and close collaboration with repair suppliers to understand their process improvement recommendations are all lessons learned from the F119 program.

Ensuring sufficient levels of new parts in inventory before the ramp of first scheduled depot maintenance visits is the last key lesson from the F119 program. In the beginning of scheduled depot maintenance, each engine module brings learning opportunities and discoveries of new and different deterioration that could not have been foreseen. Planning for sufficient amounts of parts to create a rotatable pool of new and repaired parts to support depot turn-time reduction and compensate for long piece-part repair times while processes are matured is of critical importance. The creation of a rotatable pool of parts requires preplanning and is an invaluable resource for the duration of a program to enable engine/module supportability. We are pursuing the opportunity to create a right-sized rotatable pool for the F135 program but note that part funding challenges have created some headwind.

While not exhaustive, the above summation of people, process, and parts lessons from the F119 program highlights the key learnings the F135 program is leveraging from its predecessors. We continue to learn from the F119 program as we strive to maintain high readiness levels and pursue our cost-reduction objectives to enable an affordable F135 sustainment program.

QUESTIONS SUBMITTED BY MR. BROWN

Mr. BROWN. The Office of the Secretary of Defense has responsibility and funding to address deficiencies in the defense industrial base and to assure availability of suppliers to DOD for critical technologies. We are aware that the Department has identified OLED technology as critical to the F-35 Program and a host of other DOD programs, most notably that it is a solution for the category one deficiency for "green glow" in the HMD.

What is your investment plan is to identify and apply sufficient funding to the domestic Active Matrix Organic LED industrial base to ensure a supply chain for future military displays?

When do you estimate the OLED solution will be fielded for all operational F-35 aircraft?

Secretary LORD. DOD conducted an industrial base assessment of the organic light-emitting diode (OLED) microdisplay industry in 2018, from which it identified a single qualified domestic supplier and a potential second source supplier. Currently, F-35 relies on a single source supplier to resolve the green glow issue in the Helmet Mounted Display (HMD). In order to improve the health of the OLED industrial base, the DOD has invested \$8.75M since CY2014 to help improve technology maturity and manufacturing methods. The F-35 JPO is actively engaged in ensuring the domestic OLED supplier continues its business with military customers through continuing to place new orders. The JPO is currently receiving its first order of 62 Helmet Display Units (HDUs). The JPO also released a request for proposal (RFP) for an additional order of 62 OLED HDUs in October 2019 with award expected to support OLED HDU deliveries in Q4 CY2020. Having a qualified second source supplier is equally as important as maintaining the health of the primary source supplier. The F-35 Enterprise is working with Lockheed Martin (LM) and Collins Aerospace to identify and qualify a second OLED manufacturer within the United States by Q4 CY2021. In parallel, LM has also been directed to further mature the OLED HDU design, which will productionize OLED HDU requirements throughout the F-35 Enterprise in Lot 14 (FY2022) and beyond. The Industrial Policy office within the Under Secretary of Defense for Acquisition and Sustainment conducted a site visit to the only qualified OLED microdisplay supplier in November 2019. The Assistant Secretary of the Army (Acquisition, Logistics and Technology) ASA(ALT) and F-35 JPO SMEs accompanied the site visit in order to fully understand the challenges faced by the supplier in satisfying the warfighter's needs and maintaining its health within the defense industrial base. The Department, along with the services, is working on a funding plan to assure the availability of domestic OLED microdisplay suppliers.

Mr. BROWN. The Air Force, Navy, and Marine Corps recently signed a memorandum that directs acquisition programs to incorporate open architectures into our major programs to ensure that we have the agility to stay ahead of our adversaries. The F-35 was developed before these standards were established. As we look to Block 4 and beyond, has the F-35 Program identified which of the modern standards (including but not limited to OMS and FACE) will be required in future software releases beginning with Block 4 and how interoperability will be maintained between the competing architectures of each service?

Secretary LORD. Block 4 hardware and software changes have opened the F-35 architecture to more efficiently accept OMS and FACE applications. One OMS development effort is currently underway—embedded training (ET). Additionally, one FACE effort is awaiting contract award; this effort is directed at examining how an existing FACE application could fulfill a Block 4 capability (Required Navigation Performance Area Navigation). Additionally, each of the Block 4 capabilities are being examined on a case-by-case basis to determine the ability of an OMS/FACE application to fulfill new F-35 requirements. TR3 hardware, a key hardware enabler for Block 4 capabilities, has been developed using Commercial off the Shelf (COTS) processors and industry standard interfaces enabling the integration of OMS and FACE applications into the F-35. TR-3 enables OMS/FACE and fields with software release 40P01. The Program will never be fully OMS compliant across all F-35 capabilities but we will aggressively leverage its use on those capabilities for which the OMS standards are suitable.

Mr. BROWN. The establishment of the Joint Simulation Environment has been identified as the primary requirement that is preventing the necessary testing for the F-35 program to complete IOT&E.

What have been the reasons for the delay, and how is this affecting the transition to full rate production?

Intellectual property issues have been given as a reason for delay in integration. Yet, the F-35 has been successfully integrated in other simulation environments such as the Virtual Warfare Center, which is run by Lockheed's competitor Boeing, for over a decade. What's the difference in intellectual property here that is driving the delay?

Secretary LORD. Difficulties with integration of F-35 In-A-Box (FIAB), a Lockheed software model incorporating actual F-35 air vehicle software and fusion algorithms into the Joint Simulation Environment (JSE), have been the primary driver for delays in preparing JSE to support IOT&E. Completion of IOT&E and the following DOT&E report are required before the decision to move into Full Rate Production can be made. The F-35 models integrated into the Virtual Warfare Center and the JSE vary in fidelity and application. The Virtual Warfare Center utilizes the Virtual Cockpit which is an LM licensed effects-based model that emulates the projected

performance of the F-35. This allows the Virtual Warfare Center to be used for requirements development and scenario excursions but it does not operate at the fidelity of actual F-35 performance to allow accreditation for IOT&E activities or use for future developmental activities. To be suitable for that purpose, the JSE utilizes FIAB, a high-fidelity model based on the actual F-35 operational flight program software and fusion algorithms. Specific to the Joint Simulation Environment, LM asserts that certain portions of FIAB were developed exclusively at private expense, limiting the Government's right to use it. The Government challenged LM's assertions and determined that LM failed to support its assertions of development exclusively at private expense. LM appealed the Government's determination to the Armed Service Board of Contract Appeals. The JPO negotiated Special License Rights with LM for FIAB that are sufficient to support JSE requirements pending the outcome of the appeal.

Mr. BROWN. The Office of the Secretary of Defense has responsibility and funding to address deficiencies in the defense industrial base and to assure availability of suppliers to DOD for critical technologies. We are aware that the Department has identified OLED technology as critical to the F-35 Program and a host of other DOD programs, most notably that it is a solution for the category one deficiency for "green glow" in the HMD.

What is your investment plan is to identify and apply sufficient funding to the domestic Active Matrix Organic LED industrial base to ensure a supply chain for future military displays?

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General FICK. The F-35 JPO is fully aware of and actively engaged with the Organic Light Emitting Diode (OLED) manufacturing challenges and has made continuing investments to improve domestic OLED industrial capabilities associated with the Program. Specifically, the JPO is addressing this concern by initiating a second order of 62 OLED Helmet Display Units (HDUs). The Request for Proposal (RFP) for this second order was released from the JPO in October 2019 with award expected to support OLED HDU deliveries Q4 CY20. The F-35 Enterprise is also working with Lockheed Martin (LM) to identify and qualify a second OLED manufacturer within the United States. In parallel, LM has been directed to further mature the OLED HDU design which will productionize OLED HDU requirements throughout the F-35 Enterprise in Lot 14 (CY22) and beyond. The F-35 program is currently taking delivery of the first order of 62 F-35 OLED HDUs to support the first two carrier-based F-35C squadrons for the United States Navy (USN) and United States Marine Corps (USMC). To date, 37 OLED HDUs have been received, with the remainder to deliver by February 2020. The combined 124 OLED HDUs to be delivered across both orders have been coordinated with the USN/USMC to meet requirements through CY23.

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General FICK. Difficulties with integration of F-35 In-A-Box (FIAB), a Lockheed software model incorporating actual F-35 air vehicle software and fusion algorithms into the Joint Simulation Environment (JSE) have been the primary driver for delays in preparing JSE to support IOT&E. Completion of IOT&E and the following DOT&E report are required before the decision to move into Full Rate Production can be made. The F-35 models integrated into the Virtual Warfare Center and the JSE vary in fidelity and application. The Virtual Warfare Center utilizes the Virtual Cockpit which is an LM licensed effects-based model that emulates the projected performance of the F-35. This allows the Virtual Warfare Center to be used for requirements development and scenario excursions but it does not operate at the fidelity of actual F-35 performance to allow accreditation for IOT&E activities or use for future developmental activities. To be suitable for that purpose, the JSE utilizes FIAB, a high-fidelity model based on the actual F-35 operational flight program software and fusion algorithms. Specific to the Joint Simulation Environment, LM asserts that certain portions of FIAB were developed exclusively at private expense, limiting the Government's right to use it. The Government challenged LM's assertions and determined that LM failed to support its assertions of development exclusively at private expense. LM appealed the Government's determination to the Armed Service Board of Contract Appeals. The JPO negotiated Special License Rights with LM for FIAB that are sufficient to support JSE requirements pending the outcome of the appeal.

Mr. BROWN. Nearly every major fighter program in recent history has undergone a power plant upgrade that has enabled greater performance. With increasing threats such as faster, longer range air to air missiles and new technologies on the horizon like directed energy that will require additional power generation, the F-35 will likely be no different. How important is the Advanced Engine Technology Program to future blocks of the F-35, and how does a potential new engine fit into JPO's plans for the program?

General FICK. The F-35 aircraft and F135 engine meets the warfighter's requirements today and will continue to provide sufficient power and cooling through the development and fielding of our Block 4 capabilities. Therefore, at this time there is no plan to re-engine with an Adaptive Engine Transition Program (AETP) propulsion system. New F-35 requirements are articulated by our warfighters in a Draft Statement of Requirement (DSOR) document and submitted through the Requirements Working Group into the Joint and International F-35 Governance Structure. To posture the program to respond in the event a propulsion-related DSOR is generated, the F-35 Operational Advisory Group (OAG) has approved a study to determine propulsion and related Thermal Management System (TMS) growth requirements for the F-35 in Lot 17 and beyond. The JPO is currently developing a Statement of Work (SOW) to define the study scope and deliverables. This study, along with the associated user requirements for potential future capabilities, will help determine when a new or upgraded F-35 engine may be required.

Mr. BROWN. Which portions of the F-35 contract have unlimited rights, government purpose rights, restricted rights, and limited rights? At what point do the government purpose rights transition to unlimited rights? Where do the contractor and government disagree over which rights are granted?

General FICK. There are currently thousands of items of technical data and computer software on F-35 contracts for which Lockheed Martin (LM) and its suppliers have asserted the Government has less than unlimited rights. Beyond these assertions, the full magnitude and impact of limitations on the Government's ability to obtain and utilize F-35 technical data and computer software is unknown. We find ourselves in this situation because initial F-35 development contracts did not require the delivery of appropriate technical data and the fact that contractors do not generate a data assertion until a contractual delivery requirement exists. We did not request delivery of these elements of technical data because early F-35 development was executed in a Total System Performance Responsibility (TSPR) environment. Specific to the Joint Simulation Environment, LM asserts that certain portions of F-35 In-a-Box (FIAB) were developed exclusively at private expense, limiting the Government's right to use FIAB. The Government challenged LM's assertions and determined that LM failed to support its assertions of development exclusively at private expense. LM appealed the Government's determination to the Armed Service Board of Contract Appeals. The JPO negotiated Special License Rights with LM for FIAB that are sufficient to support JSE requirements pending

the outcome of the appeal. Government purpose rights transfer to unlimited rights five years after award of the contract action that required development of the item. The contractor and government agree on the process outlined in the Defense Federal Acquisition Regulation System (DFARS) that specifies the level of rights the government obtains in technical data and computer software based on how development of the data and/or software are funded. The government has formally challenged Lockheed Martin's assertion that it developed nine components of F-35 In-a-Box software exclusively at private expense, as noted above. F-35 In-a-Box is currently the only formal data rights challenge on the F-35 program. Future challenges may arise in the event our program needs for technical data encounter Lockheed Martin (or sub-contractor) assertions that those data are not available for delivery or use.

Mr. BROWN. The Air Force, Navy, and Marine Corps recently signed a memorandum that directs acquisition programs to incorporate open architectures into our major programs to ensure that we have the ability to stay ahead of our adversaries. The F-35 was developed before these standards were established. As we look to Block 4 and beyond, has the F-35 Program identified which of the modern standards (including but not limited to OMS and FACE) will be required in future software releases beginning with Block 4 and how interoperability will be maintained between the competing architectures of each service?

Mr. ULMER. Lockheed Martin started the F-35 with open architecture attributes available at original contract award. Doing so was part of the design. Over 70% of F-35 software is Supplier provided software. The SDD contract had requirements for Open Systems although the Air Force and Navy had not established OMS and FACE standards. The JPO utilized a series of reviews led by the Software Engineering Institute (SEI) to assess compliance with the goals by the Modular Open System Architecture (MOSA) consortium, which has been rebranded to Modular Open System Approach. These reviews produced positive findings and these attributes still support the services' goals going forward.

1. Mission Systems, which is the area of focus for OMS, was modeled at the system level and at the software level using the Unified Modeling Language (UML) using stereotypes and design patterns assured common patterns throughout the design that provided for both modularity and reusable software across domains.

2. For SDD COTS operating systems were chosen for use in Mission Systems. This included the Mercury Systems Operations System which was the dominate Operating System used in that domain at that time and supported many of the POSIX APIs. For the general-purpose processing Green Hills Integrity 178 was selected and ultimately directed by the contract because of the high security assurances. For Technology Refresh 3 (TR3) both Operating Systems will be replaced by Linux for the non-safety critical processing which is compliant with both FACE and OMS. The safety critical processing will utilize a COTS OS that supports a subset of POSIX required under the FACE safety critical profile.

3. The software is also developed with layers that isolate application software from the underlying hardware and Operating System. This layer has allowed the Mission System Software to transition between TR0, TR1 and TR2 with ease and allowed the software to be easily moved to the Linux based trainers. The transition to TR3 is also expected to be straight forward. As Lockheed Martin worked with the USG on the acquisition strategy for the Technical Refresh 3 (TR3) processor, Lockheed Martin continued pursuit of open systems architecture. During this time, the USG considered FACE, HOST, and OMS, each of which have some different constructs.

The program has established an approach for evaluating new capabilities and how OMS or FACE can be applied.

1. Many of the new capabilities are simply expansions of functionality of existing components in the system. In this case the best approach may be to implement the new capability by simply modifying the existing components. This approach minimizes additional translation software and additional regression testing. There will be exceptions and they are discussed below.

2. When a new capability includes adding new components to the system, then those components would be assessed for a FACE or OMS solution. The selection of which standard would be driven by multiple factors. a. If the component has safety or nuclear considerations, then OMS is not applicable, and FACE would have to be used. b. If a component already exists that is FACE or OMS compliant, then that would determine the approach. c. The JPO, based on future use on other programs, directs the use of either FACE or OMS and the basis for the new component.

3. There is also the potential that an existing F-35 component has a potential for use on other programs. In that case, the JPO can direct that existing components be converted to OMS or FACE. This would cause additional cost for the F-35 but may save costs in other areas. Components that impact the integrated sensor man-

agement and fusion or safety critical threads could cause significant regression testing which would need to be considered.

Finally, it is critical to realize that as the F-35 modernizes, complex improvements are being incorporated. The nature of the highly integrated F-35 computational need will not change. This means that as a single-seat fighter with the potential to fly well into “harm’s way”, that fusion and the balance of all F-35s have to operate in a rapid integrated manner in order to counter our enemies’ advancing threat. As such, there is no separate F-35 architecture for one service vs another. While Lockheed Martin can and does integrate other developers’ applications and capabilities, the baseline software is structured to enable continued integration of other people’s software, while preserving dominance of our fighter for our services, partners and foreign military sales countries.

Mr. BROWN. The establishment of the Joint Simulation Environment has been identified as the primary requirement that is preventing the necessary testing for the F-35 program to complete IOT&E.

What have been the reasons for the delay, and how is this affecting the transition to full rate production?

Intellectual property issues have been given as a reason for delay in integration. Yet, the F-35 has been successfully integrated in other simulation environments such as the Virtual Warfare Center, which is run by Lockheed’s competitor Boeing, for over a decade. What’s the difference in intellectual property here that is driving the delay?

Mr. ULMER. The U.S. Government Joint Simulation Environment (JSE) has been working to integrate its first model-based Fifth Generation weapons system, the F-35, into an amalgamated Land, Sea, and Air simulation environment to conduct testing and accredit the simulation as a supplement to open-air formal Operational Testing. This high-fidelity simulation environment requires complex representations of the F-35; including Operational Flight Program (OFP), real-time models, and other software code for each major piece of hardware, weapon, software algorithm and any key features of the Air System. The F-35 is a highly integrated air system utilizing inputs from all its sensors, mission planning, and on-board data to coalesce and fuse an operational picture with attack options for the single-seat pilot. This is different from most, if not all, fourth generation weapons systems. Fourth generation weapons systems employ federated building blocks that can be worked separately; however, the strength of the F-35 comes from tight integration where all systems work together to achieve dominance. However, when the USG first embarked on the JSE integration, more of a federated approach was anticipated by government JSE personnel. This approach met with integration difficulties and resulting delays; including, the necessary work such as USG delayed accreditation of the NAVAIR special access development facility in Oct 2018. As time progressed, the JSE realized that Lockheed Martin was needed to help stand up models and integrate them in a tightly integrated simulation environment. Hence, at the USG’s request, Lockheed Martin has placed full-time support personnel in place at Patuxent River NAS and routinely brings in subsystem experts to stand up their capability. The JSE and LM teams are working closely together to help integrate F-35 baseline and subsequent modernization capabilities into Joint Simulation Environment (JSE). With respect to the question regarding the JSE simulation vs the Lockheed Martin F-35 presence at the Boeing Virtual Warfare Center, it is important to understand there are fundamental differences between the two. Lockheed Martin has a similar high-fidelity simulator “VSIM” (F-35 Verification Simulator) which provided key knowledge and experience helping JSE integrate this Fifth-Generation capability. Both JSE and VSIM are unlike the Virtual Warfare Center’s (VWC) implementation which is “effects based.” Put simply, the VWC maps effects-based outputs to a given set of input stimuli. The VWC is able to have a lower-fidelity simulation environment as the facility is used to identify technology investments and tactical considerations but is not being used to supplement flight test requirements. During testimony, the PEO cited Intellectual Property (IP) as the issue that drove JSE to be late. Even though there were Intellectual Property issues that needed to be worked, Lockheed Martin demonstrated our working VSIM in an LM developed environment for the JSE team to duplicate if desired. The F-35 simulation is comprised of many models—just some of which are Northrop Grumman Radar, BAE electronic warfare, and many different suppliers’ models. It had literally taken years for Lockheed Martin to obtain licenses and/or permission to utilize these models in our VSIM product. In fact, over 70% of the F-35 is represented by suppliers external to LM F-35 program. Most of those models were not covered in LM’s licenses/permissions as transferable to the USG and LM did not own them nor have rights to provide them to others. However, LM did have one aspect of wholly LM developed IP that is the root of all our Fifth-Generation high-fidelity simulations that support

our VSIM models to run in real time. LM licensed this capability to JSE and upon special request (over and above the license) showed the source code to named NAVAIR personnel to help JSE progress even more. Even after LM highlighted the F-35 OFP and helped identify the supplier's models necessary, there were other parallel activities that had to be worked for JSE to be successful outside of Intellectual Property constraints. In the timeframe of concern, JSE began procuring simulation computers, environments, F-35 cockpits, and other hardware enablers for their high-fidelity simulation. Unfortunately, their initial federated view of the simulation need did not push the JSE team into taking advantage of LM technical help to integrate quickly, which led to delays in standing up the JSE. In summary, LM believes the USG underestimated the complexity of implementing F-35 5th Generation highly integrated technology into a high-fidelity simulation environment. Further, in the beginning the USG attempted to be successful without involving Lockheed Martin for rapid learning and support, only contributing to the delays. The delays are technical in nature—making multiple models into tightly integrated code which must run in real time with fusion engines and is much more complex than a VWC effects-based simulation. The LM and JSE team are working closely together, progressing rapidly, and are fully teamed for success.

Mr. BROWN. Nearly every major fighter program in recent history has undergone a power plant upgrade that has enabled greater performance. With increasing threats such as faster, longer range air to air missiles and new technologies on the horizon like directed energy that will require additional power generation, the F-35 will likely be no different. How important is the Advanced Engine Technology Program to future blocks of the F-35, and how does a potential new engine fit into Lockheed's plans for the program?

Mr. ULMER. Lockheed Martin, along with the F-35 Joint Program Office, Government Think Tanks, and Industry, continuously evaluate the capabilities of our adversaries to identify enhancements for the F-35 Air System. The threats are evolving at a rapid pace with focus areas in producing large quantities of Fifth Generation-like fighter platforms, Unmanned Air Vehicles (UAVs), Surface-to-Air Missile Systems (SAMS), long-range weapons, Naval assets, powerful radars, lasers, hypersonics, cyber, and expanding their frequency diversity to include passive systems. Not only are they advancing their weapon systems into each of these areas, but they are producing in numbers that drive our 5th Gen capability for the future. Lockheed Martin applies Operational Analysis (OA) to not only analyze F-35 capability needs for this future fight, but also to evaluate the F-35 improvements necessary when operating in joint multi-domain operations against this advancing threat. Lockheed Martin's OA shows that a propulsion system upgrade improves tactical and operational performance of the F-35 against the advanced threats expected to be deployed in the 2025–2030 timeframe. This propulsion upgrade allows for improvements in range, thrust, and Power and Thermal Management System (PTMS) capacity to support advanced sensors and system upgrades that will deliver dominance against our adversaries. As our adversaries improve their capabilities with longer range weapons, the F-35's range and persistence needs to increase. In addition, enabling the F-35 to carry additional weaponry will improve lethality but will require external carriage of many of the enhanced weapons. To allow for increased range with these external weapons, range and thrust enhancements are required. In addition, due to adversary mission systems improvements, the F-35 must continuously evolve software and hardware capabilities. Those new F-35 mission systems will require PTMS improvements. Throughout the Block 4 (Follow-on Modernization) efforts, Lockheed Martin continuously evaluates the full mission capabilities required to derive the range, thrust, and PTMS capacity remaining in the platform for additional enhancements. Lockheed Martin views the Adaptive Engine Transition Program (AETP) as a critical technology development and maturation effort that offers significant propulsion system improvements for the F-35A and potentially F-35C variants. Our F-35 technology development roadmaps include a propulsion system upgrade with the AETP engine. Lockheed Martin is working with AFLCMC, Pratt & Whitney, and General Electric to evaluate integration of the AETP engine in the F-35 aircraft. This effort is designed to facilitate an abbreviated engine upgrade Engineering and Manufacturing Development (EMD) program.

QUESTIONS SUBMITTED BY MR. BANKS

Mr. BANKS. The F-35B's extended range and data collection capabilities provide targeting information far beyond the capabilities of current amphibious warships. How would a reduction in F-35Bs impact the Navy and Marine Corps distributed operations?

General FICK. The capability of the F-35B as a fifth generation fighter gives us a low-observable capability, which allows for flight in regimes and envelopes not available to fourth generation aircraft. This gives us the opportunity to penetrate non-permissive environments and destroy long-range targets that could be embedded anywhere, to include the mainland of the threat nation hosting these targets. F-35B capabilities include sensing, collecting, and in some cases destroying various targets with a significantly reduced kill-chain. The Marine Corps continuously evaluates the balance of F-35B and F-35C aircraft. The service considers both variants highly capable in the expeditionary environment for complimentary reasons. While any reduction in F-35Bs would adversely impact our ability to distribute a 5th-generation maritime capability across our Marine Expeditionary Units, those impacts can be mitigated by the capabilities of the F-35C, which can use expeditionary arresting gear to operate out of airstrips which don't allow conventional operations. A reduction in both variants, F-35B and the F-35C, would limit the Marine Corps' total TACAIR capacity and the services combat flexibility against current sophisticated enemy air defenses threat capabilities which will certainly continue to advance over time. The remaining life of our aging legacy fleet, whose efficacy against future threats is limited, stresses the importance of having available F-35B aircraft to support transition. Ultimately, a reduction in F-35B aircraft limits support to distributed-operations requirements assigned in OPLANS and puts at risk the capacity to support Global Force Management in support of the National Defense Strategy.

Mr. BANKS. With so much uncertainty around a "mix" of F-35B and F-35Cs, how is the DOD working with industry suppliers to clarify future production rates?

General FICK. The JPO stays in continuous discussions with the U.S. Marine Corps and the Department of the Navy regarding their aircraft requirements. As decisions are contemplated, we discuss with our industry partners to ensure they understand our capacity demands and timing requirements. Lockheed Martin currently has capacity to build 57 F-35Bs and F-35Cs per year in its Ft Worth, TX facility. Beginning in Lot 15, that capacity increases to an F-35B/F-35C mix of 60 aircraft per year. There is additional capacity to produce three additional F-35Bs per year at the Italian FACO in Cameri, Italy.

Additionally, as we prepare to release the Lot 15 Request for Proposal (RFP), we will be requesting variable quantity pricing to accommodate any reasonable changes in the mix after the RFP has been released. We have remained in dialogue with both Lockheed Martin and Pratt & Whitney about potential for change to minimize any negative impacts.

Mr. BANKS. What is the status of Lockheed Martin developing alternative sourcing for Turkey suppliers?

Mr. ULMER. Source selection of all parts requiring alternate sources is complete. As of 10 December 2019, 98% of the parts are forecasted to not have supply disruption with a 31 March 2020 cutoff. There are currently 15 non-supporting parts to a 31 March 2020 Turkish supply cutoff which include: Collins Aerospace landing gear subcomponents (6 parts), Northrop Grumman center fuselage major component (1 part), Northrop Grumman non-center fuselage hardware (2 parts), Lockheed Martin Airframe machined parts (3 parts), and Marvin Alternate Mission Equipment (3 parts). If the source of supply from Turkey is not allowed to continue through December 2020, the non-supporting parts are projected to create production line impacts that may result in behind schedule deliveries for up to 81 aircraft. Lockheed Martin continues to work closely with our supply base to expedite part deliveries to support the 31 March 2020 cutoff or develop production mitigation plans to minimize impacts to aircraft production and delivery.

Mr. BANKS. What are some of the challenges to agile software development, such as ALIS, when doing business with the government? Are there things Congress or the Department can do to help speed things up so we are getting technology improvements to the warfighter more rapidly?

Mr. ULMER. Lockheed Martin has numerous experiences developing software using agile methodologies in the execution of government contracts. From those experiences we have seen practices that have worked well and practices that could be improved. The following are some practices that we have seen that could be improved upon and recommendations for improvement:

- Upfront contracting actions can delay the start of program execution and release timelines due to lengthy proposal and negotiation timelines. In addition to needing separate contracts for development and release of software, which drive two contract proposals, the lack of flexible contracting, including no Time and Materials contracts and limited Level of Effort contracts, forces detailed Statements of Work to be negotiated and limits flexibility after contract award.

It is recommended that these processes be reviewed for improvement where appropriate.

- Individual contracts have varying requirements for software development artifacts/reviews/metrics. For example, some contracts have requirements for Preliminary Design Reviews and Detailed Design Reviews, whereas other contracts have moved away from the requirement for these reviews and instituted periodic incremental reviews. A consistent and reduced set of artifacts/reviews/metrics across software development contracts would allow for greater efficiency in the development efforts.
- Government Security Clearances take many months to process. This slows down the ability to ramp up staffing for new projects with developers needed to work classified software development. An improved cycle time for Government Security Clearances would allow fast ramp up of new projects.
- Authority To Operate (ATO) timelines for IT systems used to execute contracts can slow the start of projects by months. Similarly, ATO of contracted products can add several months into product delivery schedules, delaying release to production. It is recommended that the ATO process be reviewed to identify opportunities for improved performance while maintaining the appropriate security posture.
- Historical oversight practices (such as audits) that are applied to agile software development can be unnecessarily burdensome and contradicts the stated goals of agile software development principles. They have the effect of requiring unnecessary documentation to be produced which does not contribute to the quality of the product. The necessity of these practices should be reviewed against the value they provide and scaled back when appropriate.
- In some programs, contracts have been executed that specifically prevent the complete development cycle from being employed. For example, software development was funded, but per the statement of work, complete test was specifically disallowed from being performed. This results in a non-agile process on programs intending to use the agile methodology. It is recommended that this practice be avoided in future contracts.
- After development and test are complete often the release of the product to the warfighter is delayed by various certification activities, including, but not limited to weapon certification, airworthiness, and export authorization. Lockheed Martin recognizes the vital importance of these activities and the desire to deliver capability to the warfighter as rapidly as possible, and to that end we are recommending that these processes be more effective and efficient by utilizing all available advances in technology to compliantly expedite these efforts.
- Funding: Consistent and synergistic funding of Agile pursuits has been a challenge. Due to contracting issues, but also funding within the contracts, the ability to perform contracted Agile work ebbs and flows between isolated contracts, as well as within contracts where funding is provided in piece parts.
- Earned Value (EV): The ANSI Standard DCMA Imposed EV system has inherent difficulties dealing with Agile. For instance, in Agile we do Program Increment planning routinely within a given contract—where scope and pursuits are adjusted. Further, progress is reported on “Storypoints” and other non-standard methodologies that the traditional EV tools and report formats do a poor job reflecting. These practices, if improved, could directly reduce the time to deliver capabilities to the warfighter by using current technology to compliantly reduce the duration of contract award, development, and post development activities. Lockheed Martin looks forward to working collaboratively with the government to identify improvements to these practices.

QUESTIONS SUBMITTED BY MR. BACON

Mr. BACON. In response to House report language in the FY19 NDAA, earlier this year DOD confirmed to the committee significant limitations related to F-35 sensor data processing, storage, in-flight transmission and post-mission data retrieval and dissemination. a) Please provide the current Block 3F system capability and limitations to collect, store and transmit content and complex metadata associated with synthetic aperture radar (SAR), moving target indicator (MTI), multi-spectral electro-optical (EO) and infrared (IR) and RF electromagnetic transmissions; b) Please provide all Block 3 and Block 4 system program requirements to collect, store and share information collected by F-35 sensors.

General FICK. There are no outstanding significant limitations to the Block 3F system capability to collect, store, and transmit complex metadata; no Category I Deficiency Reports (DRs) exist related to these capabilities. With the introduction

of Block 4 capabilities, however, there is an overall requirement for improved data processing, handling, and storage to facilitate collection, storage, and sharing of data from F-35 sensors and Mission Systems. The Technology Refresh 3 (TR3) hardware upgrade of the Integrated Core Processor, Aircraft Memory System, and Panoramic Cockpit Display Electronics Unit and Display Unit will be introduced in 2023 (Lot 15) to provide a minimum of 4 times the current processing power as well as significantly improved data storage capacity. Further detail on full Block 3 and Block 4 system program requirements in this area can be provided in an appropriate setting at the committee's convenience.

Mr. BACON. In response to my question last year, the JPO stated that the F-35 program had no requirement to transmit a digital call for fire (CFF) request and likewise had no requirement to be interoperable with Army and Navy fire control systems like AFATDS, TLAM etc. Please confirm if this is still the case and summarize how the F-35 intends to provide digital CFF and targeting support to U.S. and NATO Army, Navy, Marine and SOF units in permissive and contested EMS environments.

General FICK. The F-35 does not have a requirement for digital Call For Fire (CFF). However, the F-35 has several means to communicate digitally with various ground and air support units to facilitate air to ground targeting. Ongoing studies related to further data dissemination in permissive environments continues to feed F-35s requirements and roadmaps. New F-35 requirements are articulated by our warfighters in a Draft Statement of Requirement (DSOR) document and submitted through the Requirements Working Group into the Joint and International F-35 Governance Structure.

Mr. BACON. Last year in response to my question the JPO stated that new tools were being fielded to shorten the timeline to create a new mission data file (MDF), then estimated to take 12–18 months. a) Have these tools been fielded and how long does it currently take the USRL to create a new mission data file? b) When a new threat is detected, how long does it take to push an update to the F-35 defense system?

General FICK. a) Yes, several improvements to the current tools, reprogramming lab infrastructure, and reprogramming processes continue to reduce the time to produce and field mission data files (MDFs). While multiple factors affect MDF production timelines, we are seeing that production timelines are trending in the right direction. To field a new MDF in a new region of the world, the predicted timeline is currently approximately 16 months. Additional improvements are scheduled for fielding by February 2020, which will bring that timeline down to approximately 9 months.

b) The United States Reprogramming Lab is currently producing mission data file updates for new threats in an existing MDF between 22–118 hours. As mentioned above, multiple factors can affect this timeline. The same tool and infrastructure improvements cited above are projected to reduce these production timelines as well.

